



HEALTH IMPACT ASSESSMENT OF THE  
MASSACHUSETTS DEPARTMENT OF  
TRANSPORTATION (MassDOT) GROUNDING  
McGRATH STUDY  
DRAFT RELEASE FOR PUBLIC COMMENT



4/5/2013

Massachusetts Department of Public Health  
Bureau of Environmental Health





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**Health Impact Assessment**  
**of the Massachusetts Department of Transportation (MassDOT)**  
**Grounding McGrath Study**

**DRAFT RELEASE FOR PUBLIC COMMENT**

**30 day comment period**  
**April 5, 2013 – May 5, 2013**

Public comments may be submitted to  
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## 1. INTRODUCTION

In 2009, Massachusetts enacted a transportation reform law that significantly modified the state's transportation agency in order to streamline operations, share services and reduce costs. A key public health feature of the law was the establishment of a Healthy Transportation Compact (HTC) that was charged with adopting best practices to achieve positive health outcomes through the coordination of land use, transportation, and public health policy.

The HTC is co-chaired by the Secretary of the Executive Office of Health and Human Services (EOHHS) and the Massachusetts Department of Transportation (MassDOT). Other members include the Secretary of the Executive Office of Energy and Environmental Affairs (EOEEA), the Administrator of Transportation for Highways, the Administrator of Transportation for Mass Transit, and the Commissioner of Public Health.

M.G.L. Chapter 6 Section 33 of the transportation reform law directs the HTC to:

- (v) establish methods to implement the use of health impact assessments (HIAs) to determine the effect of transportation projects on public health and vulnerable populations; and
- (x) institute a health impact assessment for use by planners, transportation administrators, public health administrators and developers.

The Massachusetts Department of Public Health Bureau of Environmental Health (MDPH/BEH) was awarded funds from the Health Impact Project (HIP), a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts, to assist the HTC in implementing the HIA directives by conducting a pilot HIA of a transportation planning study. The pilot HIA is intended to provide the framework for developing methods for use of HIAs in transportation planning. The pilot HIA was structured to be conducted in tandem with an active Massachusetts Department of Transportation (MassDOT) study in order to provide supplemental health data to better inform optimal transportation design alternatives. The MassDOT worked closely with the Massachusetts Department of Public Health (MDPH) in the selection of the transportation project to pilot an HIA. This pilot HIA provides supplemental information to the MassDOT Grounding McGrath Study (MassDOT GM Study) currently underway in Somerville, MA. The grant from Health Impact Project also supported the development of draft proposed criteria to determine which types of transportation projects might benefit from conducting an HIA and the process to make such determinations. The proposed criteria will be released in a separate document. The opinions expressed in this report are those of the author(s) and do not necessarily reflect the views of the Health Impact Project, Robert Wood Johnson Foundation or The Pew Charitable Trusts.



## 2. IMPLEMENTATION OF THE PILOT HIA

### 2.1. Steps of the HIA Process

HIA seeks to improve the quality of policy decisions by evaluating the likely positive and negative health impacts from proposed programs or policies, and making recommendations to improve positive health impacts and mitigate negative impacts. HIAs provide a unique opportunity for public health officials and the communities they represent to work collaboratively across agencies and secretariats to promote the idea of health in all policies. The HIA is a public engagement and decision-support tool that can be used to assess planning and policy proposals, and make recommendations to improve the health outcomes associated with those proposals. An HIA systematically analyzes how a proposed project, plan, or policy affects environmental, social, demographic, and economic conditions that drive the health and wellbeing of communities and, in turn, how these impacts are likely to positively or adversely influence health. The HIA evaluates factors such as transportation, employment status, income, noise, air/water quality, access to goods and services, and social networks —often collectively referred to as “determinants of health”— that have well-demonstrated and reproducible links to health outcomes (HIP, 2011).

The goal of an HIA is to inform the decision-making process and recommend strategies that best protect and promote health (Bhatia, 2011). The five guiding principles of HIA are:

- Involvement and engagement of stakeholders to inform a decision,
- Consideration of the distribution of health impacts across the affected population with specific attention to vulnerable groups,
- Consideration of both short- and long-term impacts and benefits,
- Objective evidence-based synthesis of methods and data to assess impacts and inform recommendations, and
- Comprehensive assessment of health that considers physical, mental, environmental, economic and social determinants of health.

The HIA methodology integrates these guiding principles into a six step process that forms the basis for a decision support tool. The five phases of the HIA are described below and also form the organization of this report.

- The first step, or **screening** phase of the HIA, evaluates whether the HIA can inform the decision-making process associated with a policy or project that is under active consideration. MDPH/BEH worked with MassDOT and other members of the HTC staff to identify transportation projects that were underway that would possibly benefit from an HIA. The team selected the Grounding McGrath Study in Somerville, MA.
- Following the screening phase, the **scoping** phase, identifies the pathways and health effects/benefits of concern, develops an approach for identifying data sources and information for evaluating health effects/benefits, and identifies tools and methods for assessing health effects/benefits associated with the project. Identifying the roles of



stakeholders in prioritizing research questions and providing data or other information for evaluating health impacts/benefits also takes place in the scoping phase.

- The **assessment** phase evaluates the health impacts/benefits by applying methods and tools for analyzing data collected in the scoping phase, and predicts changes to health if recommendations included in the HIA go forward
- **Recommendations** are developed to improve positive health impacts and mitigate negative impacts identified in the HIA.
- This report constitutes the initial phase of **reporting and communicating** the findings of the pilot HIA.
- The final step of the HIA is **evaluation and monitoring**. Evaluation can be an analysis of whether the health impact assessment was conducted according to its plan of action; an analysis of whether the health impact assessment influenced the decision-making process or had other beneficial outcomes, such as informing the public and building new partnerships or collaborations; or an analysis of whether the health impact assessment caused changes in health outcomes via continual monitoring.

### 3. SCREENING

#### 3.1. Selection of MassDOT's Grounding McGrath Study for the Pilot HIA

The screening phase of an HIA determines the need and value of the HIA to inform the decision-making process. The MDPH/BEH worked closely with HTC agency staff to screen active transportation planning projects to determine the optimal project for the pilot HIA.

The McGrath Highway (also known as Route 28) is primarily a four-and six-lane divided highway that spans approximately 1 mile. The highway includes a combination of an elevated overpass, known as the "McCarthy Overpass," as well as at-grade roadways that traverse and bisect neighborhoods in Somerville. Originally built to connect the northern communities to Boston in the mid-1950's, the functionality of the McGrath Highway changed significantly after the construction of an interstate highway through Boston (Interstate 93). The McGrath Highway is currently in poor condition, and the "McCarthy Overpass" was officially rated "structurally deficient" by MassDOT's Highway Division in 2010. MassDOT determined that restoration of the elevated structure will require significant concrete work, steel repair and deck reconstruction. MassDOT concluded that the size of the investment necessary to complete this work suggested that other options should be considered. Specifically, MassDOT believed that it was opportune time to evaluate the feasibility, benefits, impacts, and costs of removing at least a portion of the elevated structure and commissioned a study to further explore these options.



The primary influences on health that will be affected by this decision include: the current barriers to physical activity due to lack of sidewalks and the current transportation infrastructure, impeded mobility and access to neighborhoods located east and west of the highway; pedestrian safety; lack of access to jobs, goods and services, schools, churches, businesses, and recreational areas (e.g., Charles River) due to current land use and other factors, decreased property values, exposure to air pollution and noise, and lack of green space. Concerns about these health impacts have been raised by Somerville residents, area legislative representatives and local and state government agencies. The potential for disproportionate impacts to residents in the community surrounding McGrath Highway is significant, given that the area is designated by the EOEEA as an Environmental Justice community. Hence, socio-economic factors including income, housing availability/costs, and access to medical care are important factors that need to be considered in the baseline health assessment of a transportation project. Given that the location of the McGrath Highway in Somerville, MA is a densely populated area, the number of people likely to be impacted is significant. For these reasons, improving the overall transportation infrastructure on McGrath Highway could potentially address a wide range of public health impacts particularly among vulnerable populations living in Somerville.

The Grounding McGrath Study is considered an exploratory study that will evaluate existing baseline conditions, a 2035 No-build scenario, and proposed recommendations for structural improvements. The HIA analysis is intended to provide value to the decision making process by providing supplemental health data that stakeholders can consider in selecting alternative designs to the existing highway structure. Thus, the HIA will help inform how determinants of health may be considered in the development of short- and long-term recommendations at the early stages of the project. Working together with the MassDOT and other stakeholders to pilot this HIA also provides the framework for developing methods for determining what such a process would entail.

## **4. STAKEHOLDER ENGAGEMENT PROCESS**

The pilot HIA was structured to be conducted in tandem with the MassDOT GM Study in order to provide supplemental health data analysis to best inform optimal transportation design alternatives. An important feature of MassDOT's existing protocol that lends uniquely to the HIA stakeholder process is the establishment of such a process at the beginning of transportation planning studies. MDPH/BEH built their stakeholder strategy using the MassDOT stakeholder workgroup as an important communication tool. MDPH/BEH also identified a sub-group of these individuals within the stakeholder workgroup that were interested in providing additional review. The integration of the HIA process into the MassDOT GM Study provided an opportunity to familiarize transportation planners, consultants working for MassDOT, stakeholders involved in the MassDOT GM Study, and the public with the HIA process, including developing common language and understanding of the HIA framework and practice as it relates to transportation planning projects in Massachusetts. The experience in

working with stakeholders on the pilot HIA has also informed the development of a framework for integrating the HIA process into future transportation planning projects.

#### **4.1. Key Stakeholders**

The stakeholders involved in working with MDPH/BEH on the pilot HIA include:

- MDPH Bureau of Community Health and Prevention
- Healthy Transportation Compact member staff
- MassDOT and their consultants on the Grounding McGrath Study
- MassDOT Grounding McGrath Working Group that includes is community representative and stakeholders
- Grounding McGrath Working Group Pilot HIA Subteam that provided additional review and comments on the HIA
- City of Somerville School Nurse Leader (Gay Cote), Health Department (Paulette Renault-Caragianes, Director) and Office of Planning (Brad Rawson)

#### **4.2. Purpose and Scope of the Engagement**

The purpose of the stakeholder engagement process was to:

- 1) Collaborate with MassDOT staff and members of the GM Working Group to identify data generated for the MassDOT GM Study that has been publicly vetted and could be used in the pilot HIA.
- 2) Facilitate public stakeholder involvement in the HIA process by providing presentations at the GM Working Group meetings and public informational meetings on the pilot HIA. MassDOT coordinated with MDPH/BEH on the dates of the MassDOT GM Working Group and public meetings to ensure participation.
- 3) Inform stakeholders of the pilot HIA analysis by presenting draft pathways and research questions at the GM Working Group meetings. These documents were also available electronically through the MassDOT GM Study webpage dedicated to the pilot HIA with links to MDPH/BEH website. In addition, a draft final report will be provided to the GM Working Group for review and comment. MDPH/BEH plans to include final draft pilot HIA on the MDPH website to provide the public with an opportunity to comment on the document.

It is important to note that the MassDOT GM Working Group has a direct role in the selection and design of alternatives considered by MassDOT.



### **4.3. Engagement Activities**

Engagement activities involve four general approaches: (1) stakeholder meetings; (2) tiered stakeholder process; (3) posting all documents related to the pilot HIA on a website and (4) outreach to other interested groups.

#### ***Stakeholder Meetings***

##### **HIA Training**

As part of the stakeholder process, HIA training was conducted on October 5 and 6, 2011 by the Human Impact Partners (HIP) in collaboration with the Health Impact Project. Regina Villa Associates provided administrative coordination and support. Training participants included representatives from the three executive branch secretariats involved in the the HTC and importantly those individuals who will be charged with working on transportation HIA work statewide. Staff from MDPH bureaus active in HIA work, MassDOT, other state agencies, and representatives of the City of Somerville also participated, with a focus on screening and scoping of the pilot HIA.

##### **GM Working Group and Public Informational Meetings**

The engagement methods and activities to share information about the study analyses have been accomplished through stakeholder and public information meetings convened by MassDOT and attended by MDPH and others. MassDOT committed to: scheduling meetings in advance, providing opportunities for timely review of materials in advance of milestones, and seeking input on wide public meeting agendas and venues. The HIA process was integrated into this schedule to ensure stakeholder involvement. The GM Working Group meetings and public informational meetings were scheduled at each major juncture of the study where decisions needed to be made regarding the selection and design of alternatives. MDPH/BEH has participated in the four GM Working Group meetings, on June 29, 2011, August 3, 2011, and December 12, 2011 and March 7, 2012. MDPH/BEH also participated in a Public Informational Meeting held on September 21, 2011.

The MDPH/BEH has worked closely with MassDOT and their contractors as the project developed to identify and collect the information relevant to the pilot HIA. This approach also provided the opportunity to evaluate components of the transportation planning process that are amenable to the HIA process for developing methods and for consideration of criteria to identify transportation initiatives that would best benefit from an HIA.

#### ***Enhanced Stakeholder Process***

It is important to note that the GM Working Group has a direct role in the selection and design of alternatives considered in the MassDOT Grounding McGrath Study. MDPH/BEH has also

established an enhanced stakeholder process to gain input from the working group members who are specifically interested in health and the pilot HIA project.

### ***Posting all documents related to the Pilot HIA on a website***

MassDOT is maintaining a website for the Grounding McGrath Study:

<http://www.massdot.state.ma.us/planning/GroundingMcGrath.aspx>. The website contains notices of meetings as well as agendas, meeting notes, and presentation slides (including those for presentations by MDPH/BEH for meetings on September 21 and December 12, 2011). MDPH/BEH will be providing a link to the MassDOT website on the DPH portal with the following information posted:

- Power point presentations to the GM Working Group
- Draft interim documents
- Draft Pilot HIA report
- Final Pilot HIA report

### ***Outreach to other interested groups***

In addition to coordinating outreach efforts with MassDOT, MDPH/BEH has worked closely with the Central Transportation Planning Staff (CTPS) of the Boston Region Metropolitan Planning Organization (MPO) to identify and analyze data from the MassDOT Grounding McGrath travel demand model for use in the pilot HIA. MDPH/BEH has also met with officials from the City of Somerville including the Local Health Department and the Economic Development Division to gain access to city-specific data for the HIA analysis. MDPH/BEH also been actively engaged with several public and professional organizations (e.g., Association of State and Territorial Health Officials, Massachusetts local health organization) and HIA conferences (e.g., International HIA Conference in Quebec City, August 2012) that have requested presentations on the pilot HIA project. In addition, the project is receiving a significant amount of attention from the print media including newspaper articles and op-eds, Internet blogs and other forums that actively engage Somerville residents potentially affected by the project.

## **5. SCOPING**

### **5.1. Overall Approach of the Scoping Phase of the HIA**

As previously discussed, the goal of the pilot HIA is to help inform the decision making process by supplementing the transportation planning study with a systematic evaluation of potential risks, benefits and tradeoffs of planning options developed in the MassDOT GM Study. The Scoping phase of the HIA:

- Identified the alternatives to be assessed and data and methods to be used,
- Identified research questions and developed methods to address them,
- Determined which public health effects will be evaluated,



- Identified populations that might be affected including vulnerable populations,
- Identified key informants to provide community level information

According to the North American Practice Standards for an HIA, the scoping of health concerns related to the decision should include identification of the following: (1) the decision and decision alternatives that will be studied, (2) potential significant health impacts; (3) pathways, research questions, sources of data, and methods, (4) demographic, geographical, and temporal boundaries for impact analysis, (5) the identity of affected populations including vulnerable groups, (6) roles for experts and key informants, and (7) analytical plan for assessing distribution of impacts. The plan for external and public review of the draft HIA report and plan for dissemination of findings and recommendations are discussed in Chapter 9.

Conducting the HIA work in tandem with the MassDOT GM Study was accomplished by integrating the framework of the transportation planning study into the scoping phase of the HIA. Thus, the HIA has drawn extensively on the information generated from the MassDOT GM Study process. It should be noted that because the MassDOT GM Study has not yet been completed, some information or data that might optimally inform some information that might enhance the HIA are not yet available.

## **5.2. Alternatives to be considered**

The MassDOT protocol for conducting a transportation planning study requires development of alternatives that include baseline case (2035 No-build), and alternative designs advanced through the public involvement process. MassDOT selected four alternative designs to the existing highway structure. The alternatives are as follows:

- Boulevard Road Diet Alternative
- Access Road Linwood Street Alternative
- Median U-Turn Rotary Hybrid Alternative, and
- Innerbelt Alternative

All available MassDOT alternatives considered de-elevating the existing highway structure in 2035. The HIA compared alternatives to the 2010 existing conditions and the 2035 No-build option. Thus, all alternatives were developed and evaluated by MassDOT relative to traffic, demographic, economic, public transit, and vehicle technology changes projected for 2035. Three important assumptions are built into the analysis of the MassDOT GM Study: (a) development and operation of the Inner Belt and Brickbottom area with a mixture of residential, work/live studio lofts and retail stores; (b) completion and operation of the MBTA Green Line subway extension that will connect this area with the public transportation system; and (c) significant reductions from 2010 to 2035 in motor vehicle emissions from advancements in motor vehicle technology and emission control requirements.



Other important considerations in DOT's selection of alternatives included the following:

- De-elevation can only take place between two "fixed points" along the McGrath Highway in order to maintain two bridges over separate commuter rail lines (a truss bridge over the Lowell Commuter Rail Line and Squire's Bridge over the Fitchburg Commuter Rail Line) that cannot be significantly lowered. The "fixed points" (those points that are highly unlikely to be de-elevated) and the allowable slope of the roadway from the bridges represent the key issues identified by MassDOT in terms of the structure of the new roadway. Further, roadway design standards limit the distance required to de-elevate McGrath Highway from the two fixed points. According to MassDOT, this distance will be dependent on the design speed for the road, and whether pedestrian routes along McGrath Highway will follow the traffic alignment
- Opportunities for new development parcels and/or park space from an overall reduction in rights of way made possible by the elimination of elevated structures
- Each alternative has common features: a bike path along the eastern border of the McGrath highway, implementation of complete street guidelines that allow all users (pedestrians, bicyclists, motorists and bus riders) the ability to safely move along and across a complete street

The following briefly describes each alternative with accompanying maps at the end of this chapter (pages 31 - 34). Further information on alternatives is expected as they are more fully developed during later stages of the MassDOT Grounding McGrath decision-making process.

#### **5.2.1. Boulevard Road Diet Alternative**

The Boulevard Road Diet is the only alternative that may not meet the targeted traffic volume needs predicted for 2035. This alternative calls for the roadway to be narrowed to three lanes in both northbound and southbound directions. It was developed in response to requests from the Working Group. (See Figure 5-A, page 31)

#### **5.2.2. Access Road Linwood Street Alternative**

The Access Road Linwood Street design diverts some northbound circulating traffic through the Inner Belt and Brickbottom area in lieu of a northbound access road. Two alternatives to traffic, using either Joy Street or Linwood Street, were proposed. Poplar Street could be relocated slightly north of the current location. (See Figure 5-B, page 32)

#### **5.2.3. Median U-Turn Rotary Hybrid Alternative**

This alternative has a combination of a signalized rotary (at Somerville Ave.) and a median U-turn (north of Washington Street at Prospect Hill Avenue). (See Figure 5-C, page 33)

#### **5.2.4. Innerbelt Alternative**

This alternative is identical to the Boulevard Road Diet but has additional connections to and through the Inner Belt area with two features: a bridge from Inner Belt and Brickbottom area across the Fitchburg Line commuter rail tracks connecting to Inner Belt to the Northpoint development in Cambridge and Poplar Street extension across the Lowell Line commuter rail tracks connecting Inner Belt and Brickbottom area. (See Figure 5-D, page 34)

### **5.3. Scoping of Health Issues**

As mentioned, participants in the two-day training included representatives from MDPH/BEH and MDPH/BCHAP, EOHHS, MassDOT and City of Somerville, MADC, and Massport. Available information sources for conducting the HIA included the MassDOT evaluation criteria used to select the alternatives and related spreadsheets that summarized the modeling and spatial analysis of each alternative conducted by MassDOT and contractors. Preliminary input into the scoping phase was received during the October 3-5, 2011 HIA training. In addition, MassDOT provided CAD and Adobe Acrobat PDF files of the alternative designs. Information from meeting presentations, other draft materials, and decisions made at meetings of the MassDOT GM Study Working Group. MDPH/BEH staff also met with MassDOT, CTPS and contractors to review the preliminary results of the analysis of alternatives. . As noted earlier, the complete analysis of alternatives and a final MassDOT GM Study report was not available at the time that the GM HIA was drafted. However it is unlikely that information presented in the final report would substantially impact the outcome(s) of this HIA.

#### **5.3.1. The decision and alternatives that will be studied**

As discussed previously, the decision that the HIA will help inform is the selection of an alternative design for the McGrath Highway in Somerville MA. The MassDOT study is considering the potential removal of elevated portions to enhance access for all modes of travel. The HIA supplements the MassDOT GM Study evaluation criteria with health-related information to more fully inform the selection of the optimal design alternative. In order to provide a comprehensive assessment of the long-term implications of the design alternatives, the GM HIA aims to assess the health impacts/benefits of the four alternatives as well as 2010 existing conditions and the 2035 No-build case.

#### **5.3.2. Potential significant health impacts**

During the October 2011 HIA training the following health determinants that are associated with transportation planning were identified as key to the GM alternative decision:

- Air quality: Exposure to traffic-related air pollution
- Noise: Exposure to traffic-related noise
- Mobility: Impeded mobility and lack of physical activity due to existing infrastructure of sidewalks and crosswalks along McGrath Highway



- Connectivity: Impeded physical activity and access to health promoting goods and services (e.g., retail, health care, employment)
- Public safety: Injury/fatalities of pedestrian, vehicle, and cyclists; travel time for public safety vehicles
- Mental health: stress associated with noise, general neighborhood conditions
- Social cohesion: Lack of sense of community due to physical barriers under 2010 existing conditions
- Land use and economic development: access to goods and services (e.g., local businesses, medical services) and green space

In summary, the primary influences on health that were considered in the GM HIA related to how existing transportation conditions associated with the McGrath Highway may have an impact on public health in the surrounding communities. The unintended health impacts of transportation projects may include direct impacts from exposure to air pollutants, emissions of greenhouse gases, physical inactivity (due to infrastructure designs that favor motor vehicle use and limit active transportation options), pedestrian safety, mental health impacts (e.g. stressful commutes), and safety concerns (e.g., auto accidents). Indirect effects may include a lack of access to goods and services, suppressed property values and displacement, and reduced employment opportunities (Litman, 2009). In addition, public health impacts of particular concern expressed by residents at community meetings include impeded mobility and access to communities located east and west of the McGrath Highway; lack of access to goods and services, and lack of green space. Examples of health outcomes that are relevant to these health determinants are presented in **TABLE 5-1**.

**TABLE 5-1: EXAMPLES OF HEALTH OUTCOMES ASSOCIATED WITH HEALTH DETERMINANTS FOR PILOT HIA**

Health Determinants	Health Outcomes
Air pollution	Respiratory disease/illness (e.g., asthma), cardiovascular disease (e.g. heart attack)
Noise	High blood pressure, annoyance, and sleep deprivation
Mobility	Increase in physical activity and reduction in obesity, Type II diabetes
Connectivity	Increased physical activity and reduction in obesity from access to other areas near McGrath Highway and to green space.
Public Safety	Injuries/fatalities; inactivity due to fear of crime
Social cohesion	Indirect effects on broad range of physical and mental conditions
Mental health	Indirect effects on broad range of physical and mental conditions
Land use and economic development	Access to medical services, public transit to services that support health



### **5.3.3. Literature Review: Potential Impacts on Health from Built Environment**

The HIA process is driven by evidence published in the scientific and medical literature that links the transportation design and operations to direct, indirect or cumulative health impacts/benefits.

A growing body of scientific evidence has shown that the built environment can have significant effects on both physical and mental health, particularly among minority and low-income populations already burdened with disproportionate rates of illness and morbidity. Lack of infrastructure (e.g., sidewalks, bike paths, and parks), affordable well-designed housing, and lack of supermarkets with access to healthy food combine to increase the risks of both physical and mental illnesses (Hood, 2005). Aspects of the built environment also contribute to air quality, noise, and public safety.

#### **5.3.3.1. PHYSICAL ACTIVITY**

The link between physical activity and health is well-known. The U.S. Surgeon General recommends at least 30 minutes of exercise each day to reduce the risks of coronary heart disease, hypertension, colon cancer, and diabetes (CDC, 1996). In a literature review of the relationships between land use and transportation for CDC, Frank and Engelke agree that regular physical activity decreases the risks of cardiovascular disease, colon cancer, and diabetes mellitus; they add that it can help maintain muscle and joint strength, may relieve depression, anxiety and other mental illnesses, and, along with appropriate diets, may lower obesity levels (Frank and Engelke, 2009).

The built environment can impact physical activity in a number of ways. For example, Singh et al. (2010) report that children living in unsafe and socioeconomically disadvantaged neighborhoods or in neighborhoods that lack access to sidewalks, walking paths, parks, playgrounds, and recreation centers have a 30–60 percent higher likelihood of being obese or overweight than children living in neighborhoods with these amenities. Studies have also found that low-income urban communities have inadequate opportunities to participate in physical activity, which can contribute to stress, depression, anxiety and reduced ability to perform daily tasks (PolicyLink, 2002).

Existing literature highlights the importance of walking, in particular, as a form of physical activity that can be promoted by key aspects of the built environment such as distance to destinations (walkability), mixed land use, presence of sidewalks, and the connectivity of routes. Street connectivity improves the efficiency with which one can arrive at destinations and expands choices for routes to access goods and services. Access to goods and services (e.g., schools, healthy foods, medical services, public transport) within walking or biking distance promotes physical activity, reduces vehicle trips and vehicle miles traveled, and increases neighborhood cohesion and safety (CDC, 2009).



Increasing the availability of public transit can also impact walking rates. Analysis of the 2001 National Household Travel Survey by Besser et al. (2005) found that walking to and from public transportation can help promote and maintain active lifestyles, especially among low-income and minority groups. A study by Edwards et al. (2007) estimates that an individual walks an additional 8.3 minutes per day when they change from driving to transit. Frank et al. (2004) report that each additional hour spent in a car per day is associated with a 6 percent increase in the likelihood of obesity, and each additional hour walked per day is associated with a 4.8 percent reduction in the likelihood of obesity. According to Lachapelle and Frank (2009), transit users average 1.05 daily miles of walking per day – ten times more than the 175 yards of walking averaged by non-transit users.

#### 5.3.3.2. MENTAL HEALTH

Another important benefit of urban connectivity, green space, and public transit, is alleviation of mental illness, particularly depression (Sacher et al, 2012). In a review of literature on the built environment and mental health, Sacher et al. (2012) report that physical environmental conditions that provide a sense of identity, safety, security and social connection help people living with mental illness improve their recovery in the community. They also report that access to goods and services by active transportation, and increasing social interactions in neighborhoods reduces social isolation and depression, which is beneficial in promoting optimal mental health. Finally, research findings suggest that positive neighborhood environments are related to positive determinants of mental health, such as, parks for walking, while negative neighborhood environments are related to negative determinants of mental health, such as, stressors from chronic exposure to motor vehicle traffic and noise.

#### 5.3.3.3. AIR QUALITY

Regional ambient air pollution is linked to an increase in lower respiratory symptoms; reduction in lung function in children and adults; increase in chronic obstructive pulmonary disease; lung cancer; bronchitis; chronic cough; respiratory illness; chronic obstructive pulmonary disease; asthma exacerbation; and premature mortality. Both long-term (Dockery et al., 1993; Pope et al., 1995; Hoek et al., 2002) and short-term population-based health effect studies (Dominici et al., 2003; Atkinson et al., 2010) have reported associations between high levels of ambient air pollutants and cardiovascular mortality. Several studies have reported an association between ambient air pollution and nonfatal cardiac events, including myocardial infarction, (Peters et al., 2004; Pope et al., 2008; Miller et al., 2007; von Klot et al., 2008); angina/other ischemic heart disease (Schwartz et al., 1995; Miller et al., 2007; von Klot et al., 2008), dysrhythmias (Schwartz et al., 1995; Rosenlund et al., 2008), and short-term and long-term exposure to PM<sub>2.5</sub> and hospitalizations for cardiovascular disease (CVD), all respiratory diseases, stroke and diabetes (Kloog et al., 2012). A significant body of evidence exists on acute exposure to fine particulate matter and daily cardiovascular hospital admissions after adjusting for season, weather, and day of week (US EPA, 2006). Peters et al. (2001) reported in a study of 772 patients in Boston that elevated ambient fine particles triggered acute myocardial infarctions during two separate exposure periods (within 2 hours and 1 day after exposure).



In the past decade, epidemiological studies have demonstrated associations between adverse health effects and exposure to traffic-related air pollutants near major roadways. Factors that influence the spatial and temporal distribution of traffic-related pollutant concentrations include chemical reaction/transformation/deposition, meteorological conditions, traffic volume, traffic type, driving conditions and related emission rates. Monitoring studies have found that concentrations of traffic-related air pollutants decrease rapidly with distance from major roadways and typically approach background within 300-500 meters. For example, studies that have measured traffic-related air pollutants near major roadways have found steep gradients with impacts between 100-500 meters for NO<sub>2</sub>, 50-250 for elemental carbon, 100-500 for PM<sub>2.5</sub>, and 50-200 meters for ultrafine particle counts (Zhou et al., 2009). A mobile monitoring study of emissions associated with Interstate 93 in Somerville, Massachusetts observed an annual median concentration of particle number two-fold higher compared to background within 0-50 meters of the roadway (Padro-Martinez et al., 2012). Pollutants associated with mobile source emissions include particulate matter (PM<sub>2.5</sub> and ultrafine particles), carbon monoxide (CO), nitrogen oxides, diesel exhaust and volatile organic compounds, many of which are classified as hazardous air pollutants (e.g., benzene, formaldehyde).

Older adults, children, people with preexisting cardiovascular and respiratory disease, pregnant women, and low socioeconomic status predispose individuals to greater health impacts from exposure to air pollution (US EPA, 2009). In addition, research suggests that the chronic stressors related to socioeconomic status and poverty may increase susceptibility to pollutants, particularly in young children. For example, studies have found associations between traffic-related air pollution and pediatric asthma solely among urban children exposed to violence (Clougherty et al., 2007) and chronic family stress (Chen et al., 2008).

#### 5.3.3.4. NOISE

The Federal Highway Administration (FHA) defines noise as unwanted or excessive sound that can be annoying, and can interfere with sleep, work, or recreation. Walker (2012) explored the relationship between road traffic noise and sleep patterns, high blood pressure, and annoyance in Somerville, Massachusetts and found a significant and positive correlation between the modeled noise levels and resident annoyance towards road traffic noise. A study in England found that there were no statistically significant associations between road traffic noise and ischemic heart disease incidence in two studies, but there was a suggestion of effects when modifying factors such as length of residence, room orientation, and window opening were taken into account. In a sample stratified by pre-existing disease, men with pre-existing disease had an increased odds of incident ischemic heart disease for the highest annoyance category compared to men without pre-existing disease in the lowest category (OR = 2.45, 95% 1.13 - 5.31). (Stansfeld et al., 2011). A recent study by Dratva et al. (2012) found that traffic noise [during the day and night of 51 dB(A) and 39 dB(A), respectively] was associated with higher blood pressure only in diabetics, possibly due to low exposure levels. A study by Babisch (2006) presented evidence that transportation noise levels above 60 dB(A) have been associated with high-blood pressure, hypertension, and ischemic heart disease.



#### 5.3.3.5. PUBLIC SAFETY

Several studies have confirmed that there is a statistically significant relationship between traffic volume and the number of vehicle collisions involving a pedestrian. (Levine et al. 1995, Roberts et al. 1995, Jackson and Kochtitzky 2001, and CA Dept. of Transportation, 2012). Studies by Ewing et al. (2006) and Penden et al. (2009) document that higher traffic volume increases the risk of pedestrian, cyclist and motorist injury and death, with pedestrians, cyclists, and motorized two-wheeled vehicle users bearing a disproportionate share of road injury burden. A study by LaScala et al. (2000) reports that “pedestrian collisions are more common in low-income areas, potentially reflecting greater residential density, greater traffic volume, and lower automobile ownership among residents of these neighborhoods”. Racial disparities in risks associated with pedestrian crashes are reported by Roberts et al. (1994). African American and Hispanic race/ethnicity as well as uninsured status are linked to increased risk of mortality from collisions according to a study by Maybury et al. (2010). Frumkin et al. (2004) report that areas with high levels of vehicle miles traveled per capita tend to have higher collision and injury rates and that more time in a car means higher exposure to the perils of driving, including collisions. For the state of Massachusetts, the National Highway Traffic Safety Administration estimates 0.58 fatalities per 100 million VMT (NHSA, 2012).

The CDC (2012) has compiled statistics showing that motor vehicle crashes are the leading cause of death among those ages 5-34 in the U.S. A study by Beck et al. (2007) using national transportation and injury statistics, determined the risk of fatal injury per person-trip by bus in the U.S. is 23 times less than by car (0.4 versus 9.2 fatalities per 100 million person-trips) and the risk of non-fatal injury is five times less for bus trips compared to automobile trips (161 versus 803 per 100 million person-trips). The National Safety Council (2009) has determined that the lifetime odds of dying as a car driver or passenger are 1 in 261, compared to 1 in 64,596 as a bus occupant or 1 in 115,489 on a train.

#### 5.3.4. Pathway Diagrams and Research Questions

In order to inform the decision making process, pathway diagrams were discussed during the October 2011 HIA training and further developed for the HIA to link the evaluation criteria of the MassDOT GM Study with health determinants. Pathway diagrams describe effects directly related to the project and link these effects to health determinants and then health outcomes. The MassDOT GM Study identified evaluation criteria to objectively evaluate the impacts and benefits associated with alternative designs to the existing McGrath Highway such as improved access and mobility, maintenance of regional travel capacity, and support economic development. The MassDOT GM Study does not explicitly address health implications of the alternatives. Thus, to address the goal of using the HIA to inform the MassDOT GM Study decision-making process, the MassDOT’s valuation criteria was incorporated into the pathway diagrams in order to link criteria with health data. In other words, the pathway diagrams begin with MassDOT evaluation criteria and are then linked to health determinants and outcomes.



The health determinants originally identified were consolidated in the HIA and carried through into the assessment phase: (1) air quality; (2) noise; (3) mobility and connectivity; (4) public safety; and (5) land use and economic development. The pathway diagrams formed the basis of research questions to be addressed in the assessment phase. To illustrate those criteria from the MassDOT GM Study that were incorporated into the pathway diagrams, the criteria are highlighted in **red lettering**. The research questions were presented to the MassDOT GM Working Group for discussion and feedback. The major concerns expressed by members of the GM Working Group related to limitations of the CTPS Travel Demand Model for estimating traffic emissions for use in health risk assessment and the need to consider near-road exposures. To address these concerns, air dispersion modeling was conducted as part of the HIA to identify areas that are predicted to experience relatively higher exposure to traffic emissions. Near-roadway exposures were based on proximity of households within 200 meters around McGrath Highway.

Figure 5-E through Figure 5-J (pages 35 - 40) show the pathway diagrams for each of the five selected health determinants and a summary of research questions to be addressed in this pilot HIA.

### **5.3.5. Geographic and temporal boundaries and demographics for HIA**

#### **5.3.5.1. GEOGRAPHIC BOUNDARIES**

The geographical scope of the study area for the GM HIA is illustrated in Figure 5-L to Figure 5-O. The HIA study area was determined by extending the study area defined in the MassDOT GM Study to the boundaries of zip code areas adjacent to the McGrath Highway. Zip code areas represent the smallest geographical area that some health data (in this case, hospitalization data) are available. This area represents approximately 4 square miles and encompasses Inner Belt/Brickbottom, Union Square, and East Somerville neighborhoods in Somerville as well as zip codes 02141, 02142, 02143, 02145 (including small section of Cambridge) and census tracts 350103, 350104, 350200, 351300, 351402, 351404 and 351500.

#### **5.3.5.2. TEMPORAL BOUNDARIES**

It is important to note that the Grounding McGrath Study defines the 2035 highway conditions with no structural changes as the baseline case (i.e., “No-build”) and not 2010 existing conditions and hence so too does this HIA. The 2035 baseline No-build case, for example, takes into account the significant emission reductions that are predicted from the implementation of federal requirements to significantly reduce motor vehicle fleet emissions by 2035. In addition, the baseline 2035 No-build case also assumes that the Green Line Extension is operational and the development of the Inner Belt and Brickbottom neighborhood is completed. Given the need to consider the long-term potential negative and positive impacts on health from the MassDOT GM project, the HIA supplements the MassDOT GM Study by considering 2010 existing conditions compared to the baseline case in 2035 (“No-build”) and to alternative designs.



The temporal boundaries of the pilot HIA are as follows:

- Existing conditions in 2010
- Future 2035 No-build
- Future 2035 Alternative designs

#### 5.3.5.3. DEMOGRAPHICS

The demographic data are based on 2010 Census data for Somerville, MA by census tracts. General population data characteristics that will be provided include: population estimates based on 2010 Census and projected changes in population in 2035 from the CTPS Travel Demand Model, median age, race/ethnicity, high school graduate percentages, measures of socioeconomic status (i.e., poverty rate, median household income, unemployment), and average assessed value of property parcels.

#### 5.3.6. Identity of affected populations including vulnerable groups

The community surrounding McGrath Highway is designated as an Environmental Justice community according to criteria established by the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA). These criteria include the following:

- The median annual household income is at or below 65 percent of the statewide median income for Massachusetts; or
- 25 percent of the residents are minority; or
- 25 percent of the residents are foreign born, or
- 25 percent of the residents are lacking English language proficiency

Hence, socio-economic factors including income, housing availability/costs, and access to medical care are important factors that need to be considered in the baseline health assessment of a transportation project on public health and vulnerable populations. This HIA characterizes vulnerable populations in the study area by considering EJ factors (e.g., income), elderly and senior living, special needs (e.g., disabled, elderly disabled), and public housing. Supplemental data characterizing vulnerable populations was provided by City of Somerville officials.

#### 5.3.7. Roles for experts and key informants

The pilot HIA involves many partners and stakeholders.

##### 5.3.7.1. THE HEALTH IMPACT PROJECT AND HUMAN IMPACT PARTNERS

Dr. Aaron Wernham, Ms. Bethany Rogerson, and Ms. Kim Gilhuly have provided invaluable technical assistance throughout the HIA planning and development process to the MDPH HIA team. They also conducted the HIA training focused on this HIA in October 2011.

#### 5.3.7.2. CITY OF SOMERVILLE

MDPH/BEH met with representatives from the City of Somerville to discuss city-specific information available for inclusion in the HIA. Mr. Brad Rawson, Economic Development Planner for the City of Somerville, provided information on Inner Belt and Brickbottom development and an extensive GIS dataset, including locations of businesses operating in Somerville. This information was used to evaluate availability and access of goods and services, special housing, and public housing data. Ms. Paulette Renault-Caragianes, Somerville Health Director, provided health data information available to assess baseline health conditions in Somerville. Ms. Renault-Caragianes also participated in the HIA training.

#### 5.3.7.3. GROUNDING MCGRATH WORKING GROUP/COMMUNITY INPUT

On March 7, 2012 the MassDOT GM Study Working Group met in Somerville, MA to discuss the development of alternative designs to the McGrath Highway. At this meeting, Suzanne Condon, MDPH Associate Commissioner and the PI for the GM HIA, presented an update on the HIA including draft research questions for the HIA and discussed establishing an HIA Subteam to obtain additional community input on the HIA from stakeholders. Three members of the MassDOT GM Study Working Group indicated they were interested in participating in the HIA Subteam. A status update report on the HIA was also provided by MDPH/BEH Senior Environmental Analyst, Margaret Round at the September 27, 2012 the MassDOT GM Study Working Group meeting. Finally, MDPH/BEH met with Mr. Wig Zamore, member of the MassDOT GM Study Working Group, to review scientific literature related to exposure to air pollution in and around highways. MDPH/BEH also received resident input relative to concerns about the safety of the existing highway structure advocating for the de-elevation of the McGrath viaduct instead of repairing it.

#### 5.3.7.4. COMMUNITY ASSESSMENT OF FREEWAY EXPOSURE AND HEALTH

MDPH/BEH has been closely following the progress of the Community Assessment of Freeway Exposure and Health (CAFEH) study and participates as a member of the advisory board. The CAFEH study is being conducted at Tufts University through funding by the National Institute of Health and research affiliates who also participate on the MassDOT GM Study Working Group. The aim of CAFEH is to assess the association between exposure to air pollutants from highway traffic and cardiac health in communities located near highways. An important component of the CAFEH study is real-time monitoring of ultrafine particulates (UFP) emissions near roadways. Margaret Round has represented MDPH on the Advisory Committee for this study.

#### 5.3.7.5. MASSDOT AND CONTRACTORS

MDPH/BEH met regularly with MassDOT and their contractors throughout 2012 in order to keep apprised of the MassDOT GM Study analysis.



#### 5.3.7.6. CENTRAL TRANSPORTATION PLANNING STAFF (CTPS):

MDPH/BEH has worked closely with CTPS staff who have provided extensive input and output data from the Travel Demand Model for incorporation into the HIA assessment. CTPS staff also provided technical support regarding the appropriate application of modeling data.

#### 5.3.8. Analytical plan for assessing distribution of impacts

The following section provides (1) definition of the study area, (2) identification and methods for identifying baseline health data and (3) a summary of the methods to assess each of the health determinants identified above: air quality, noise, mobility and connectivity, public safety, and land use and economic development. For each health determinant, the purpose, source of data and analytical method are presented.

##### 5.3.8.1. DEFINITION OF THE STUDY AREA

The study area in the vicinity of the McGrath Highway for the MassDOT GM Study is presented in Figure 5-K (page 41). The study area for the pilot HIA was based on superimposing the census tracts, zip code boundaries and neighborhood boundaries above the Corridor Study Area defined in the MassDOT GM Study. These maps are illustrated in Figure 5-I through Figure 5-O (pages 39 - 45).

##### 5.3.8.2. BASELINE HEALTH DATA

Health surveillance data are available at a variety of geographic levels (e.g. census tract, zip code). A comprehensive baseline health assessment was conducted as part of the HIA based on existing health surveillance data at the finest geographical resolution possible (see **TABLE 5-2**).

**TABLE 5-2: HEALTH DATA, GEOGRAPHY, DATA SOURCES AND METHODS USED IN GM HIA**

Health Data	Geography(1)	Data Sources	Methods
<b>Hospitalization (inpatient) data</b> <ul style="list-style-type: none"> <li>Asthma (inpatient and ED)</li> <li>Myocardial infarction</li> <li>Congestive heart failure</li> <li>Stroke</li> <li>Hypertension</li> </ul>	By Zip code Community	Center for Health Information and Analysis (1) BEH/EPHT Portal	Rate of health outcomes in study area by zip code for 2010
<b>Pediatric Obesity, Overweight and Depression</b>	Community	School Health Services, DPH Bureau of Community Health Prevention	2009-2011 for grades 1, 4, 7 and 10
<ul style="list-style-type: none"> <li>Adult Obesity data</li> <li>Adult Hypertension</li> <li>Adult diabetes</li> <li>No exercise</li> <li>Eats 5 fruits and vegetables/day</li> </ul>	Community	BRFSS (2)	Outcomes for 2009 in Somerville
<b>Pediatric asthma and diabetes data</b> <ul style="list-style-type: none"> <li>Grades K-8</li> </ul>	Elementary schools in pilot HIA study area and community	MDPH/BEH EPHT Portal	Prevalence rates in 2008-2009
<b>Pediatric Diabetes</b>	Community	MDPH/BEH EPHT Portal	Prevalence rates in 2008-2009
<b>Injury and fatality related to traffic accidents</b>	McGrath Highway	MassDOT	2010

- (1) Formerly Massachusetts Division of Health Care Finance and Policy
- (2) Environmental Public Health Tracking portal is a web-based portal housed at MDPH/BEH that contains a variety of data including health data, environmental data and health promotion information (e.g., bike trails, walking trails)
- (3) Methodologies described in Analytical Plan section of Pilot HIA
- (4) BRFSS: Behavioral Risk Factor Surveillance System is an annual telephone survey that collects data on emerging public health issues, health conditions, risk factors and behaviors

### ***Hospitalization Data***

The MDPH/BEH obtains inpatient, emergency department (ED), and outpatient observation hospitalization data annually from all 74 acute care hospitals in MA from the Center for Health Information and Analysis (formerly the Massachusetts Division of Health Care Finance and Policy). This division collects emergency department data and inpatient hospital admissions data for all visits to Massachusetts acute care hospitals and satellite emergency facilities.



A data suppression rule is imposed when case counts are less than 7 in order to protect patient confidentiality for smaller geographic levels (e.g. ZIP code) or sparsely populated areas. Disease hospitalization rates are based on the residential location of the cases and not necessarily the location of the incident.

The data are based on primary discharge diagnosis codes (ICD9-CM) only. Cases are not included if the condition is listed only as a secondary diagnosis. The data used for this HIA are the most recent hospitalizations data available among Massachusetts residents with an admission date in the year 2010.

Using residential address information, hospitalization rates were calculated separately for the city of Somerville and each of four ZIP code areas within the pilot HIA study area. Due to the instability of rates associated with individual zip codes and the lack of a statistically significant difference in rates across the four ZIP codes, hospitalization rates are presented for the combined four-ZIP code area surrounding the proposed McGrath Highway Project.

Population data used in the calculation of incidence rates are from the 2010 US Census. The 2010 US Census provides age-stratified population estimates at the state, city, and zip code tabulation area (ZCTA) level. ZCTAs are statistical geographic entities that approximate the delivery area for US Postal Service ZIP Codes. ZCTAs are aggregations of census blocks having the same predominant ZIP Code associated with the residential mailing addresses in the Census Bureau's master address file. Incidence rates at the ZIP code level were calculated using population data for the matching ZCTAs. Rates were age-standardized to the 2010 population distributions of MA and the US into the following 10 age groups (years): 0-4, 5-9, 10-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, and 75+.

Crude and standardized rates are based on the age groups most affected by a particular disease. For example, data are restricted to ages 35 and above for rates of myocardial infarction, congestive heart failure, stroke, and hypertension. Data are restricted to ages 15 and above for rates of adult onset diabetes. For asthma, all ages are included.

### ***School Health Data on Obesity, Overweight, and Depression***

Schools are required by Massachusetts General Law to provide health screenings for students (M.G.L. Chapter 71, Section 57 and 105 CMR 200.00) and follow up with the results of these screenings with families and referrals to primary health care providers as necessary. In February 2009, Massachusetts promulgated amendments to the regulations on Physical Examination of School Children, 105 CMR 200.000, to improve the screening and monitoring of the health assessment of children across the Commonwealth. Among other changes, the amended regulations require screening for height and weight and the recording and reporting of the BMI for all students in grades 1, 4, 7 and 10 (or of comparable age).

Overweight and underweight children are at risk for a variety of health problems, making early identification of weight status important. Eating disorders such as anorexia, bulimia and binge

eating can result in serious long-term health problems and poor school performance. Overweight and obesity in children and adolescents are risk factors for a variety of serious health conditions such as Type 2 Diabetes and cardiovascular disease (*Comprehensive School Health Manual*, 2007).

Data reported to MDPH School Health Unit Bureau of Community Health and Prevention for Somerville on obesity/overweight children for 2009-2011 were summarized for this HIA (MDPH 2012). Some data were also available on depression and school students.

### **BRFSS Data**

Behavioral Risk Factor Surveillance System (BRFSS) is an annual telephone survey that collects data on emerging public health issues, health conditions, risk factors and behaviors. The BRFSS was established in 1984 by the U.S. Centers for Disease Control and Prevention (CDC) and is the largest, on-going telephone health survey system, tracking health conditions and risk behaviors in the United States. Currently, data are collected monthly in all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam. In Massachusetts, the BRFSS is coordinated by the MDPH Bureau of Health Information Research Statistics and Evaluation (BHIRSE).

The BRFSS data are not readily available at the community level because the survey is designed to provide health information statewide or by larger metropolitan areas and because a majority of communities surveyed do not have adequate sample sizes for directly calculating prevalence rates with reasonable precision (Li et al., 2009). Therefore BRFSS data are presented at the county level (Middlesex)

For the GM HIA, the MDPH/BHIRSE provided health outcome data for prevalence of Type II diabetes, obesity and hypertension in Somerville, as well as data on exercise and eating fruits/vegetables.

### **Pediatric Asthma and Diabetes Data**

The MDPH/BEH conducts pediatric asthma and diabetes surveillance in children who are enrolled in approximately 2200 public and private schools, grades Kindergarten through 8, to monitor the prevalence of pediatric asthma and diabetes state-wide and to evaluate which communities may have higher rates pediatric asthma or diabetes than the state as a whole. These data are readily available on the MDPH/BEH Environmental Public Health Tracking Portal. Information collected as part of this surveillance effort includes name and address of the school and the number of children with asthma or diabetes by gender and by grade. The city or town of residence for each child is also collected. Collection of these surveillance data enables MDPH/BEH to estimate asthma and diabetes prevalence by school as well as by city/town of residence. No child-specific information that could identify a particular student is collected. Pediatric asthma and diabetes data for school year 2008 – 2009 were summarized for the 14 schools located in the MassDOT GM study area (asthma) or by community (diabetes). These data were compared to the statewide rate.



### ***Injury Surveillance Data***

MDPH/BEH obtained traffic fatality data for McGrath Highway from 2010 Top Crash Locations Report, September 2012, MassDOT.

(<http://www.mhd.state.ma.us/downloads/trafficMgmt/10TopCrashLocationsRpt.pdf>)

#### **5.3.8.3. METHODS TO ASSESS HEALTH DETERMINANTS IN HIA**

### ***Air Quality***

Two approaches for evaluating potential air quality impacts have been developed for consideration in this HIA as well as for methodological approaches in transportation HIAs to be conducted in response to MGL c. 6 § 33(i) and (ii). The first approach utilized traffic density data contained in the CTPS Travel Demand Model. A summary of the key features of the CTPS Travel Demand Model is presented in Appendix A. The second approach used screening level air dispersion modeling to estimate air pollutant concentrations in the study area based on the CTPS Travel Demand Model air pollution emissions data. For both approaches MDPH/BEH qualitatively evaluated possible differences in air pollution impacts on health considering the proximity of sidewalks, bike paths, and community paths to roadways under the various designs. The predicted air pollution impacts also included consideration of elevation (No-build) versus de-elevation (all alternatives) on predicted concentrations in the study area.

#### **Air quality emissions based on traffic density**

Purpose: Use traffic density data as a surrogate for exposure to traffic-related pollutant emissions (e.g., PM<sub>2.5</sub>, NO<sub>x</sub>) for 2010 existing conditions, 2035 No-build, and alternative designs

Source of Data: CTPS Travel Demand Model for 2010 existing conditions, 2035 No-build and four alternative designs. The data CTPS Travel Demand Model data represent emissions during 3-hour morning and evening peak traffic periods.

Analytical Method: Traffic density is a measure of the rate of traffic flow per unit time along lengths of road within a specified area and is expressed as vehicle miles (or kilometers) traveled (VMT) per square mile (or kilometer), i.e., daily VMT/mi<sup>2</sup>. The traffic density was expressed as 3-hour morning and afternoon peak periods by traffic analysis zones (TAZs) within the GM HIA study area from the CTPS Travel Demand Model (Rioux et al., 2010).

Results: Model output was spatially interpolated by MDPH/BEH using ArcGIS Inverse Distance Weighted to create spatial traffic density contours in the study area for 2010 existing conditions, 2035 No-build, and alternative designs. In general, the lower the traffic density, the lower the potential air pollution impact on health.

## Predicting air pollutant concentrations using air dispersion modeling

Purpose: Estimate ambient air concentrations of traffic-related pollutants (e.g., PM<sub>2.5</sub>, NO<sub>x</sub>) by conducting air dispersion modeling.

Source of Data: Air quality emissions (PM<sub>2.5</sub>, NO<sub>x</sub>) data from CTPS Travel Demand Model for 2010 existing conditions, 2035 No-build and alternative designs. Scaling factors of 0.40 and 0.36 were applied to the 3-hour volumes to determine 1-hour peak AM and PM traffic volumes.

Analytical method: MDPH/BEH contracted with Dr. Bruce Egan of Egan Environmental, Inc. to conduct screening level air dispersion modeling using CAL3QHC. This is an EPA-approved dispersion model that estimates pollutant concentrations from vehicular traffic. Emissions data from the Travel Demand model were applied to this analysis. A special version (CAL3QHCi) that allows inclusion of all links for which emissions data were generated from the CTPS Travel Demand Model to allow for better air concentration estimates was obtained by MDPH/BEH from Michael Claggett of Federal Highway Administration (FHWA) specifically for this project.

The dispersion component used in CAL3QHC is CALINE-3, a line source dispersion model developed by the California Department of Transportation. CALINE-3 estimates air pollutant concentrations resulting from moving vehicles on a roadway based on the assumptions that pollutants emitted from motor vehicles travelling along a segment of roadway can be represented as a "line source" of emissions, and that pollutants will disperse in a Gaussian distribution from a defined "mixing zone" over the roadway being modeled.

For each planned roadway configuration alternative as well as the 2010 existing conditions and 2035 No-build for the McGrath Highway, emissions information on NO<sub>x</sub> and PM<sub>2.5</sub> was obtained from the CTPS Travel Demand Model output.

Modeling parameters included:

### *Model Options*

- Surface roughness length = 175 cm (urban)
- Settling velocity = 0 cm/sec
- Deposition velocity = 0 cm/sec

### *Receptor Inputs*

Concentration estimates were calculated at 986 receptor locations. These locations were based on a rectangular grid with 100-meter spacing encompassing the traffic links. Receptor heights were set to 1.8 meters above ground, assuming flat terrain.

### *Link Inputs*

Roadway link data was provided by CTPS Travel Demand Model. These data were derived from the Travel Demand Model outputs, and included the starting and ending link node UTM locations, 3-hour AM and PM traffic volumes and pollutant emissions, link length and the number of lanes for each link, for six scenarios: 2010 existing conditions, 2035 No-build,



Boulevard Road Diet, Access Road Linwood Street, Median/U Turn Rotary Hybrid, and Inner Belt.

The existing McGrath Highway is elevated above grade for portions of the project area. The source height for these links was determined from building plans obtained from MassDOT. All side streets and build case links were modeled 'at grade'.

CAL3QHCl was applied to determine maximum peak 1-hour NO<sub>x</sub> and PM<sub>2.5</sub> concentrations. The model uses an emission factor input in grams per vehicle-mile. These values were calculated using the provided link length, 3-hour traffic volume and 3-hour emissions. Scaling factors of 0.40 and 0.36 were applied to the 3-hour volumes to determine peak morning and evening traffic volumes (CTPS, 2012).

The mixing zone width was calculated as the width of the link plus 20 feet (extending 10 feet on each side), assuming 10-foot lanes.

#### *Meteorological Inputs*

CAL3QHCl was applied using the following 54 stability class/wind speed conditions:

- Stability Class A: 1, 1.5, 2, 2.5 and 3 m/sec
- Stability Class B: 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5 and 5 m/sec
- Stability Class C: 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 8 and 10 m/sec
- Stability Class D: 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 8, 10, 15 and 20 m/sec
- Stability Class E: 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5 and 5 m/sec
- Stability Class F: 1, 1.5, 2, 2.5, 3, 3.5, and 4 m/sec

The wind direction varied in 10-degree increments from 10 through 360 degrees. The mixing height was set to 1000 meters. No background concentration values were added to the model calculations.

Results: Model output was spatially interpolated using ArcGIS Inverse Distance Weighted total to create air concentration contours in the study area for 2010 existing conditions, 2035 No-build, and alternative designs. The air concentration contour illustrates predicted concentration 200 meters from the center of the highway for each of the 2010 existing conditions, 2035 No-build and alternative designs. This allowed for evaluation of possible differences within the study area, including within 200 meters of the McGrath Highway.

#### **Noise**

Purpose: Estimate noise level (dB(A)) at the peak traffic volume location along McGrath Highway for 2010 existing conditions, 2035 No-build and alternative designs

Source of Data: Maximum traffic volume predicted from the CTPS Travel Demand Model for 2010 existing conditions, 2035 No-build and alternative designs.

Analytical Methods: Traffic noise was modeled by MDPH/BEH for a representative section of the roadway with the maximum traffic volumes to conservatively calculate maximum noise levels for 2010 existing conditions, 2035 No-build and alternative designs using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM) Version 2.5. Five different types of vehicles types of fleet mix from the motor vehicle module (MOBILE 6.2) were obtained from CTPS Travel Demand Model for 2010 existing conditions, 2035 No-build and alternative designs. As described above, scaling factors of 0.40 and 0.36 were applied to the 3-hour volumes to determine 1-hour peak morning and evening traffic volumes.

Two scenarios were modeled: the current speed limit of 35 mph on McGrath Highway and a speed limit of 45 mph. The 2010 existing conditions and 2035 No-build were assumed to be elevated, as is the current structure. A 20 foot elevation was assumed. The four alternatives were assumed to not be elevated (consistent with design assumptions). The terrain was assumed to be flat. One building row was assumed to exist adjacent to the highway. Sound levels were calculated at intervals of 50 feet from the highway up to 1300 feet.

Results: Comparison tables were generated to compare how noise levels varied with distance from the highway for 2010 existing conditions, 2035 No-build and alternative designs. These data also address questions related to impacts that may be associated with changes in traffic volume on the highway and adjacent nearby streets.

### ***Mobility and Connectivity***

For mobility, the HIA assessed the capacity of existing conditions and alternative designs to encourage walking and biking. For connectivity, the potential for increased physical activity from mode shifts and increased connectivity to nearby neighborhoods and public transit were assessed. In addition, qualitative assessment of the shift in vehicle use from McGrath Highway to nearby neighborhoods predicted from analysis of alternative designs was evaluated.

### **Mobility**

Purpose: Evaluate the capacity of alternative designs to encourage walking and biking in and around the McGrath Highway area compared to 2010 existing conditions, 2035 No-build and alternative designs.

Source of Data: To evaluate the potential for increased physical activity through increased walkability and bikeability, MDPH/BEH used the Pedestrian Environmental Quality Index (PEQI) and the Bicycle Environmental Quality Index (BEQI) developed by the San Francisco Department of Public Health (SFDPH).

SFDPH developed the PEQI as a practical method to evaluate existing barriers to walking and prioritize future investments for increasing pedestrian activity and safety in land use and urban planning processes. SFDPH consulted national experts including city planners, independent



planning consultants, and pedestrian advocates to develop the indicator weights and scores for each indicator category, based on survey responses.

The study area for the HIA includes McGrath Highway and streets located about two blocks east and west of the highway. Physical attributes of the sidewalks, location of public transit, and roadway conditions associated with 2010 existing conditions, 2035 No-build and alternative designs were evaluated. The SFDPH worked with MDPH/BEH to adapt software for conducting the survey of sidewalks and bike paths in the McGrath Highway study area. MDPH/BEH used a new version of PEQI provided by SFDPH that allowed for adaptation for use in cities outside of San Francisco.

Analytical method: The PEQI is an observational survey that quantifies street and intersection factors empirically known to affect people's travel behaviors and is organized into five categories: intersection safety, traffic, street design, land use and perceived safety. These indicators are aggregated to create a weighted summary index, which can be reported as an overall index. A PEQI score, reflecting the quality of the pedestrian environment on a 0 to 100 scale, is created for each street segment and intersection in a defined area. Below is the list of indicators for assessing pedestrian ease and security. Many of these indicators are included in the MassDOT Grounding McGrath Study evaluation criteria.

**Intersection Safety:** Crosswalks, Intersection lighting, Traffic control, Pedestrian signal, Countdown signal, Wait time, Crossing speed, Pedestrian refuge island, Curb ramps, Intersection traffic calming features, Pedestrian engineering countermeasures

**Traffic Volume:** Number of vehicle lanes, Posted speed limit, Traffic volume, Street traffic calming features

**Street Design:** Continuous sidewalk, Width of sidewalk, Width of throughway, Large sidewalk obstructions, Sidewalk impediments, Trees, Driveway cuts, Presence of a buffer, Planters/gardens

**Land use:** Public seating, Retail use and public places, Public art/historic sites

**Perceived safety:** Pedestrian scale lighting, Illegal graffiti, Litter, and Empty lots

The BEQI is similar in many respects to PEQI. It has 22 empirically-based indicators, each of which has been shown to promote or discourage bicycle riding and connectivity to other modes of transport. SFDPH identified five main categories which are considered important physical environmental factors for bicyclists: Intersection Safety, Vehicle Traffic, Street Design, Safety, and Land Use. The indicators summarized below can be aggregated to create the final index (the BEQI), which can be reported as an overall index score, and/or deconstructed by the bicycle environmental categories.

**Intersection Safety:** Dashed Intersection Bicycle Lane, No Turn on Red Signs, Bicycle Pavement Treatment and Amenities

**Vehicle Traffic:** Number of vehicle lanes, Vehicle Speed, Traffic calming features, Parallel Parking Adjacent to Bicycle Lane/Route and Street, Traffic Volume, Percentage of Heavy Vehicles

**Safety/Other:** Presence of Street Lighting, Presence of Bicycle Lane or Share Roadway Signs

**Land Use:** Line of site, Bicycle Parking, Retail Use

Results of PEQI and BEQI Analyses: For the GM HIA, Google Maps Street Views were generated to assist MDPH/BEH in completion of the BEQI and PEQI surveys. Once the data entry is complete, the information is mapped using ESRI ArcGIS software. Streets are color coded depending upon PEQI scores, ranging from less than 20: Unsuitable for Pedestrians (red color), to 81-100, Ideal pedestrian conditions exist (green color). For BEQI, streets are color-coded ranging from <20, Environment not suitable for bicycles to >80, ideal bicycling conditions. MDPH/BEH evaluated the PEQI and BEQI color-coded maps for 2010 existing conditions, 2035 No-build and alternative designs to assess potential differences that would enhance walkability and bikeability and hence physical activity and health. In addition, overall BEQI and PEQI scores for each design were calculated for comparison.

### Connectivity

Purpose: Evaluate the potential for increased physical activity through shifts in travel mode (e.g., from auto to walking) and increased connectivity to nearby areas (e.g., Union Square).

Source of Data: Mode share and travel time data generated from the CTPS Travel Demand Model was used to evaluate changes from in mode share (e.g., auto to transit and walk/bike) across neighborhoods. Pathways were selected from the MassDOT GM Study evaluation criteria (e.g., from Sullivan Square across McGrath Highway to Union Square and travel along McGrath Highway).

Analytical Methods: Access by auto, walk/bike, and public transit on specific roadways was evaluated using mode share data from 2010 existing conditions, 2035 No-build and alternative design analysis. Two paths evaluated in the MassDOT GM Study were selected for analysis - Washington Street from Maffa Way to Union Square (eastbound and westbound) and Medford Street and McGrath Highway from School Street to Rufo Street (Northbound and Southbound). These were selected to assess east-west (Washington Street) and north-south (Medford Street to McGrath Highway) directions across McGrath Highway including the areas that are proposed to be de-evaluated. These are graphically displayed in Figure 5-P (page 46).

Results: The potential for increased physical activity by shifting from auto to walk/bike along the two routes described above (i.e., along Washington Street and Medford Street) has been estimated using the following factors:

- 20 minute/mile brisk walking is associated with moderate intensity aerobic exercise (Warburton et al., 2006)



- The physical inactivity index for Massachusetts is defined as less than 30 minutes of moderate physical activity most, if not all, days of the week (Chenoweth et al., 2006).

### **Vehicle Diversion from McGrath Highway to Adjacent Neighborhoods**

**Purpose:** There is considerable concern about the potential for an increase in traffic in adjacent neighborhoods as a result of vehicle diversions from McGrath Highway associated with the alternative designs because increased traffic in neighborhoods could result in increased health impacts. A qualitative evaluation of the potential health impacts of the diversion of vehicles from McGrath Highway to nearby neighborhoods was conducted.

**Source of Data:** To evaluate vehicle diversion, MDPH/BEH used the MassDOT GM Study analysis of the diversion of traffic from McGrath Highway onto three neighboring streets (Pearl Street, Medford Street, and Cross Street).

**Analytical Methods:** MDPH/BEH presents the data on estimate of diversion of traffic from McGrath Highway to adjacent neighborhoods and qualitatively evaluate these trends in terms of potential health impacts (e.g., on respiratory conditions, noise nuisance) in the assessment section of this report.

**Results:** Table of change in number of vehicles diverted to neighborhoods adjacent to McGrath Highway.

### ***Public Safety***

**Purpose:** Evaluate the potential for injuries or fatalities associated with 2010 existing conditions, 2035 No-build, and alternative designs. Evaluate travel times for public safety vehicles across subject designs.

**Source of Data:** (1) Because injuries and fatalities are related to higher traffic volume or vehicle miles traveled per capita, data on vehicle miles traveled (VMT) from the CTPS Travel Demand model were evaluated. (2) The Travel Demand Model also provided information to calculate expected travel time on the McGrath Highway under the different designs to address whether public safety vehicle travel may be different.

**Analytical Methods:** (1) Areas with high levels of vehicle miles traveled per capita tend to have higher collision and injury rates. For Massachusetts, the National Highway Traffic Safety Administration estimates 0.58 fatalities per 100 million VMT and 75 injuries per 100 million VMT (NHSA 2009). The VMT data for the 2010 existing conditions, 2035 No-build, and alternative designs will be evaluated for estimated rates of fatalities based on the NHSA estimate. (2) The Travel Demand Model provides vehicles speeds during average uncongested conditions, as well as delays from congested conditions. Average and congested travel times along a southbound section of McGrath Highway were calculated as follows: travel

time on specific links was determined by driving link length by either average uncongested speed or congested speed to calculate link travel time. Travel times for links that constitute McGrath Highway southbound were summed to determine total average travel time and total congested travel time. Travel times were calculated for the 2010 existing conditions, the 2035 No-build, and the four alternatives.

Results: (1) Results are reported on comparisons of predicted fatalities and injuries based on NHSA statistics. (2) Develop table of average and congested travel time along McGrath Highway for 2010 existing conditions, 2035 No-build, and alternative designs.

### ***Land Use and Development***

Purpose: Assess access to multiple goods and services and green space as a surrogate for comparing land use and economic development for 2010 existing conditions, 2035 No-build and alternative designs. The MassDOT GM Study predicts substantial changes to land use and economic development in 2035. One of the major problems with 2010 existing conditions on McGrath Highway is access to goods and services on and across neighborhoods abutting McGrath Highway.

Source of Data: The City of Somerville provided maps of existing goods and services and green space (e.g., parks) in the McGrath Highway area. DPH/BEH staff prepared GIS data layers of these goods and services.

Analytical Methods: Inventory of existing goods/services and planned new open space in the vicinity of McGrath Highway (one-quarter mile) for 2010 existing conditions, 2035 No-build, and alternative designs were evaluated. Access to multiple destinations for goods and services within one-half mile of McGrath Highway will be assessed by evaluating various demographic data (e.g., number of households, income, education) of households that have access within walking distance to goods and services under 2010 existing conditions, 2035 No-build, and alternative designs. Goods and services included schools, new goods and services in the Inner Belt and Brickbottom neighborhoods, and new public transit via Green Line extension.

Results: Map of key features (e.g., number of crosswalks, block length, pedestrian walking width) comparing access of existing conditions, baseline and alternatives.



## 5.4. Figures

FIGURE 5-A: BOULEVARD ROAD DIET ALTERNATIVE DESIGN









FIGURE 5-C: Median U-Turn Hybrid Rotary





FIGURE 5-D: INNERBELT ALTERNATIVE





FIGURE 5-E: AIR QUALITY PATHWAY

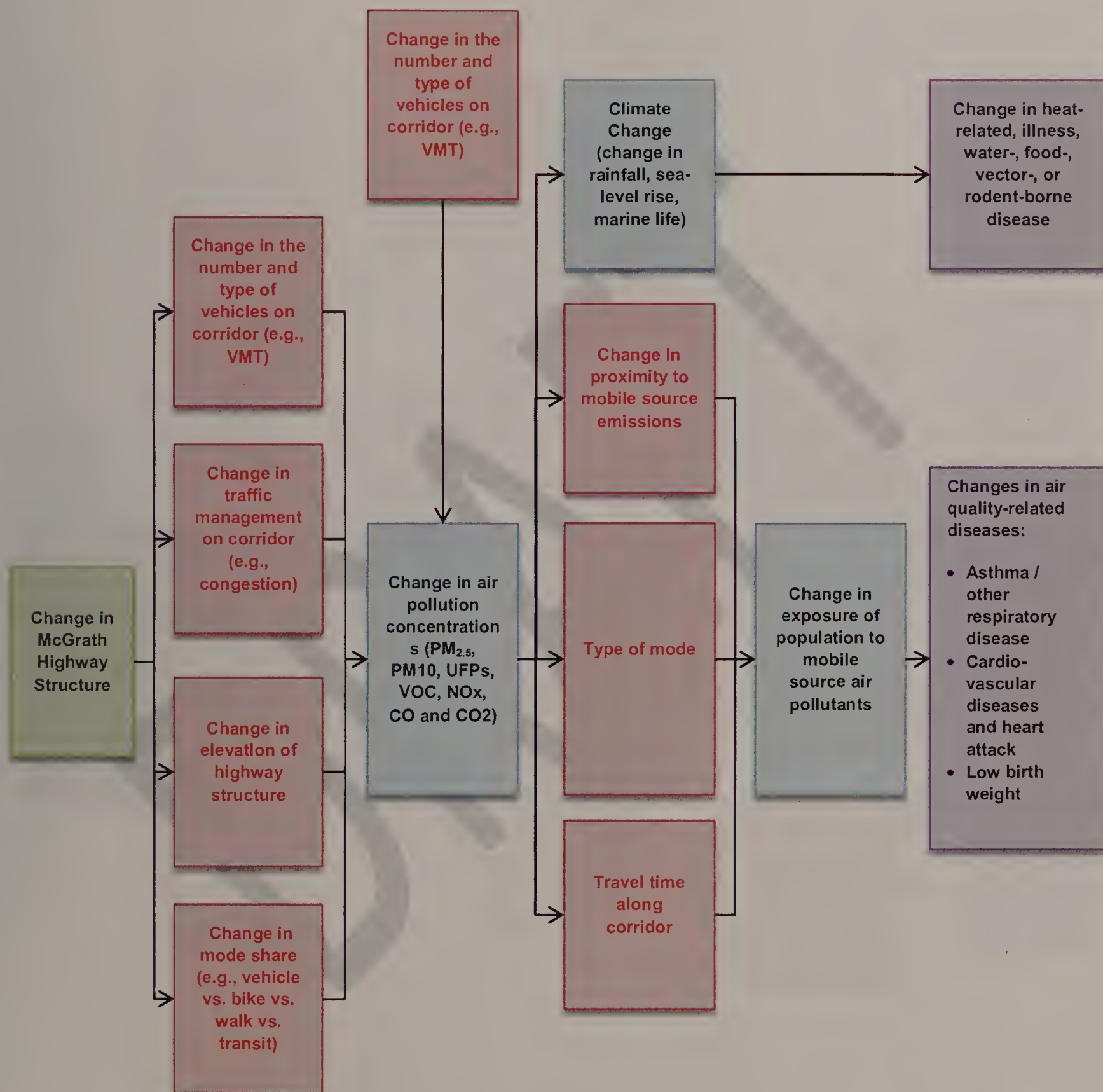


FIGURE 5-F: NOISE PATHWAY

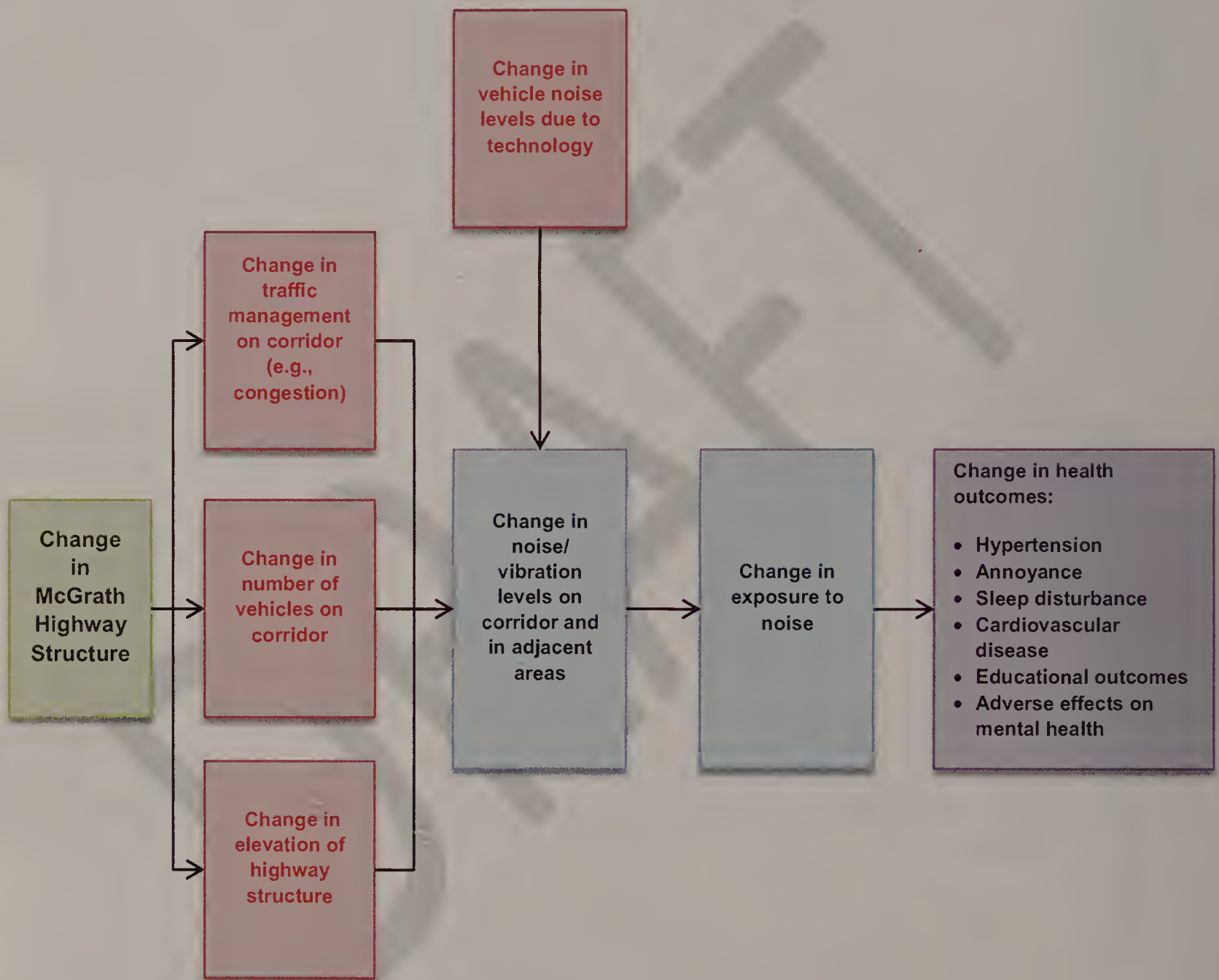




FIGURE 5-G: MOBILITY AND CONNECTIVITY PATHWAY

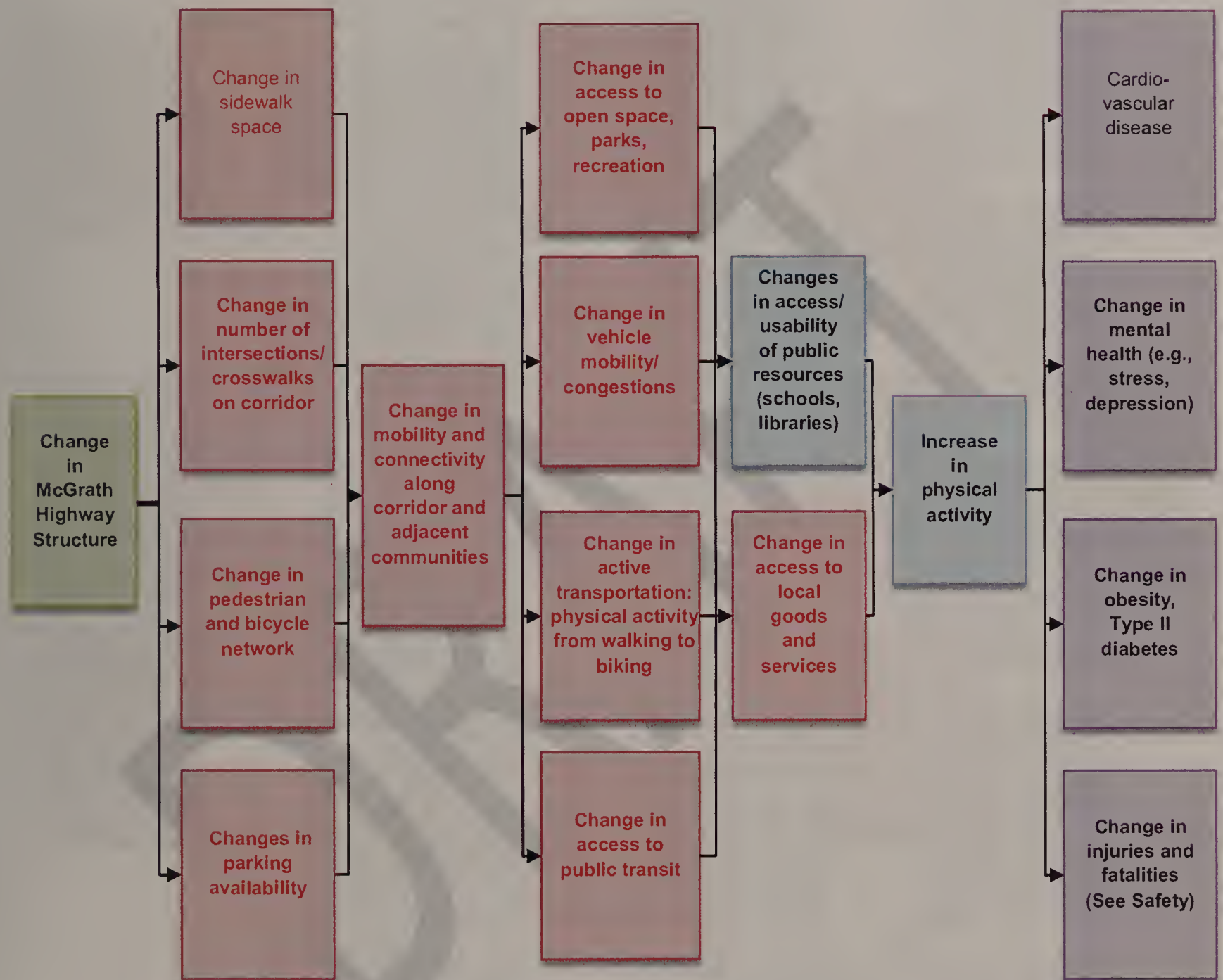


FIGURE 5-H: PUBLIC SAFETY PATHWAY

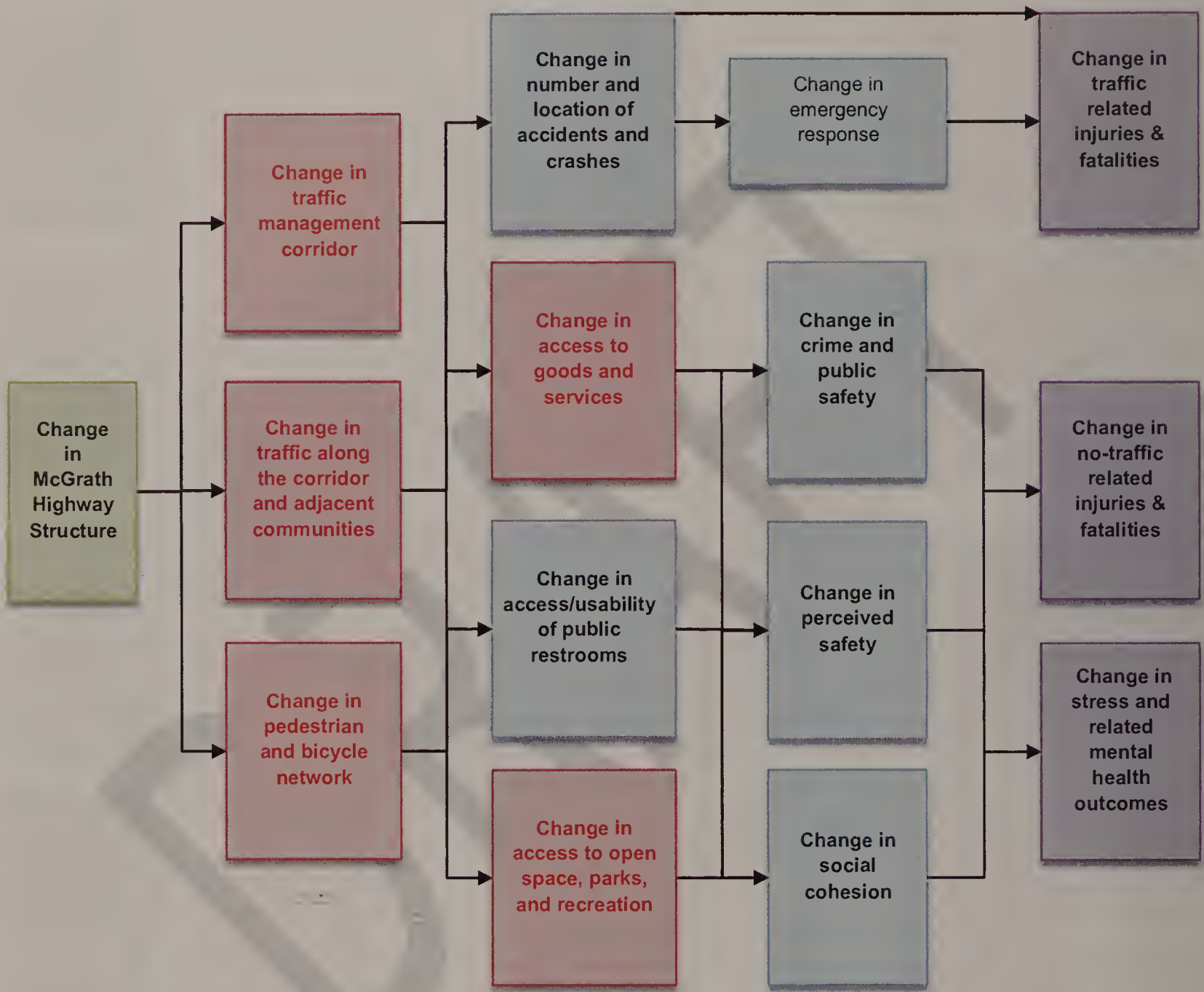
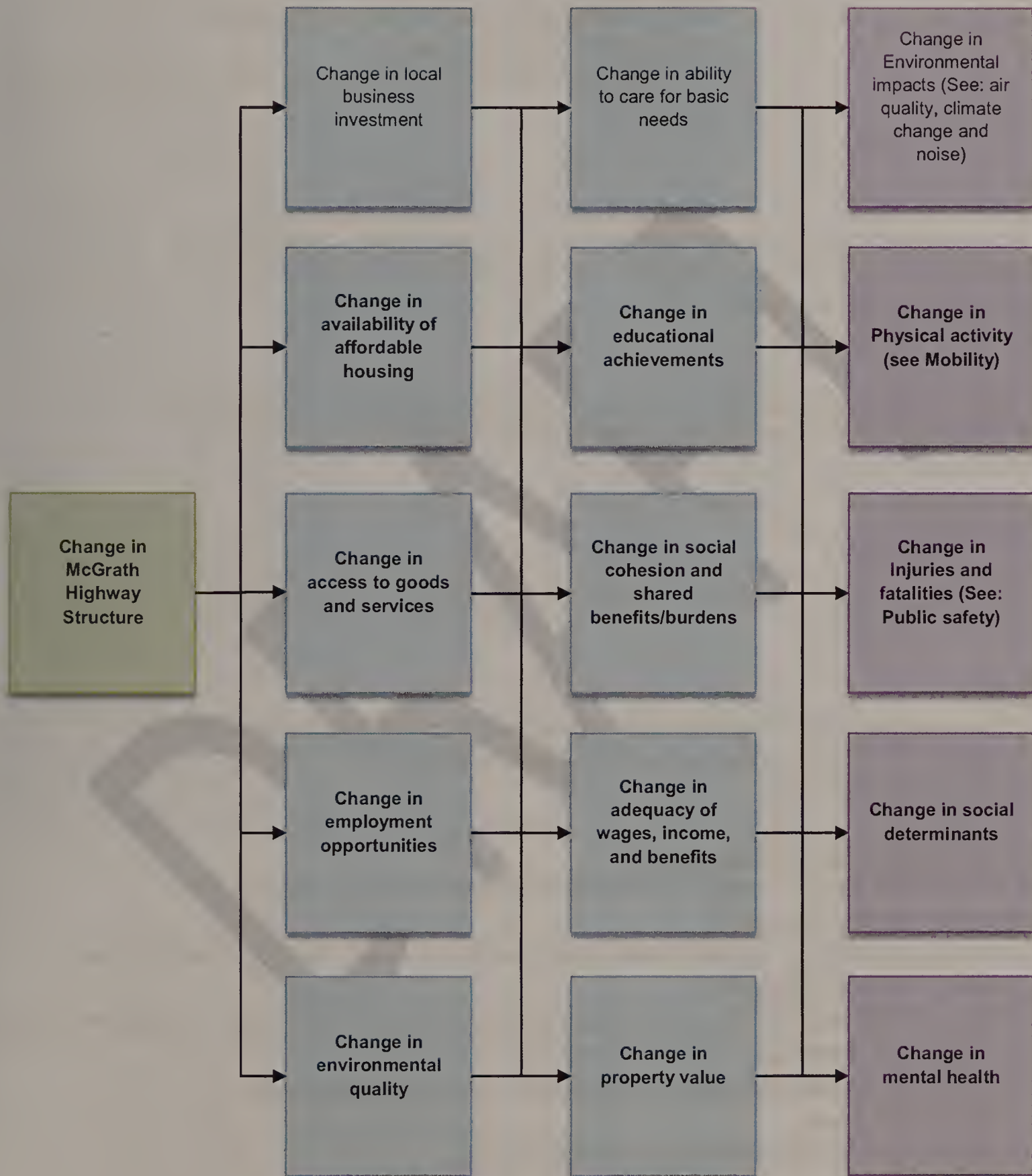




FIGURE 5-1: LAND USE AND ECONOMIC DEVELOPMENT



## FIGURE 5-J: RESEARCH QUESTIONS

### Air Quality

***What are the public health impacts/benefits associated with changes in:***

- Air pollution from vehicles including technology changes
- Proximity within 200 meters of roadway (for indirect measure of ultrafine particles and higher gradient of vehicle emissions)
- Elevation of corridor

### Noise

***What are the public health impacts/benefits associated with changes in:***

- Noise along corridor and adjacent streets from increases in vehicle in intersections, proximity, and technology changes
- Elevation of corridor

### Mobility and connectivity via traffic, transit, pedestrian/bicycling network:

***What are the public health impacts/benefits associated with changes in:***

- Vehicle use on corridor
- Vehicle use in adjacent areas
- Pedestrian/bicycle use
- Access and use of public transportation (e.g., transit buses, Green Line Extension)
- Regional and local linkages via mode of transport (e.g., Union Square, Inner Belt and Brickbottom)

### Public Safety

***What are the public health impacts/benefits associated with changes in:***

- Injuries and fatalities associated with vehicle collisions
- Crime and fear of crime

### Land Use and Economic Development

***What are the public health impacts/benefits associated with changes in:***

- Local business investment
- Access to goods (e.g., grocery store, pharmacy) and services (e.g., health care providers, schools, libraries)
- Housing and affordable housing (including possibility of gentrification and displacement)
- Land use (e.g., Inner Belt and Brickbottom)
- Availability and access to parks, open space, and community path
- Transportation costs
- Preservation of historical and cultural resources



**FIGURE 5-K: STUDY AREA FOR THE MASSDOT GROUNDING MCGRATH STUDY**



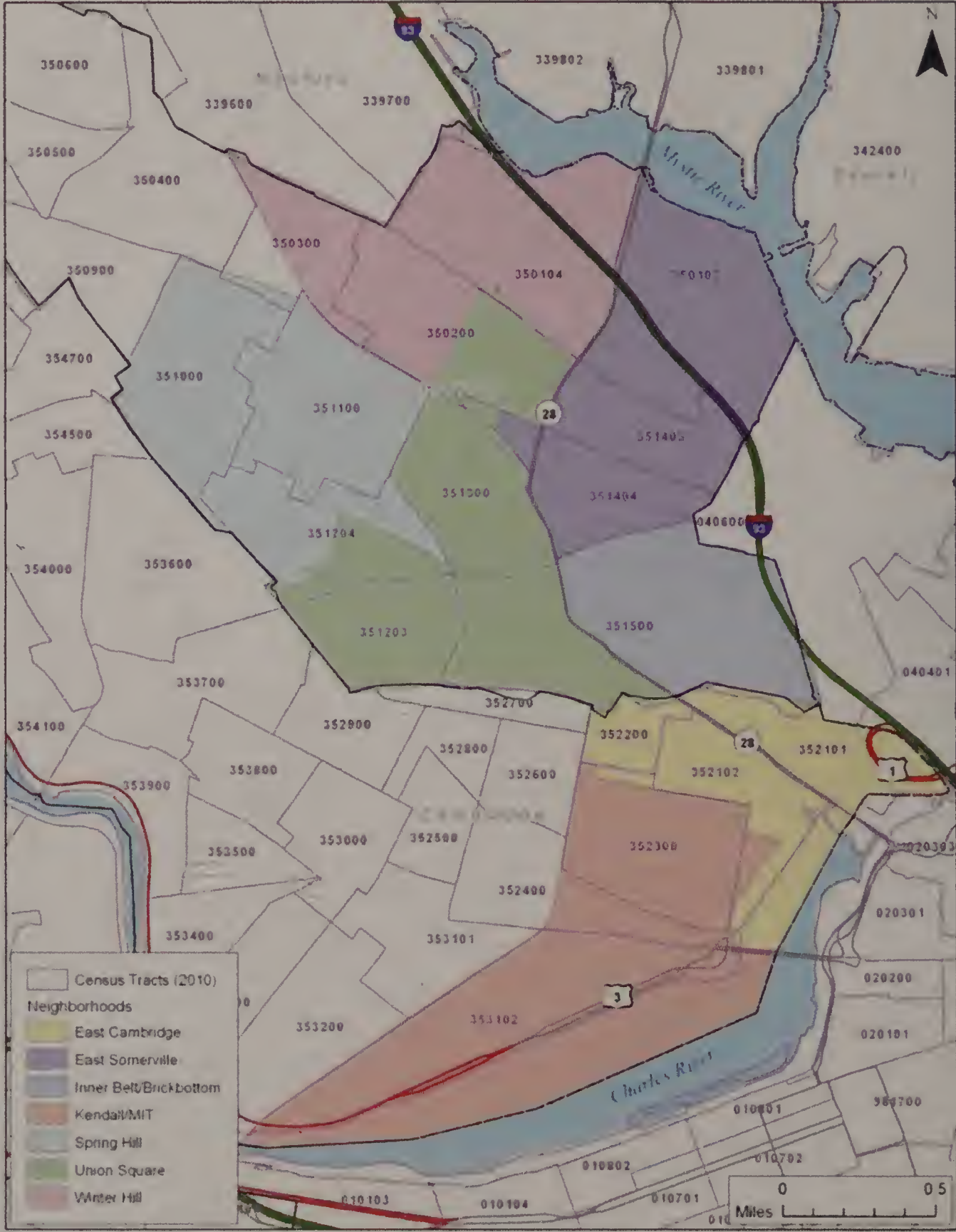




FIGURE 5-M: PILOT HIA STUDY AREA ACCORDING TO ZIP CODES IN SOMERVILLE, MA

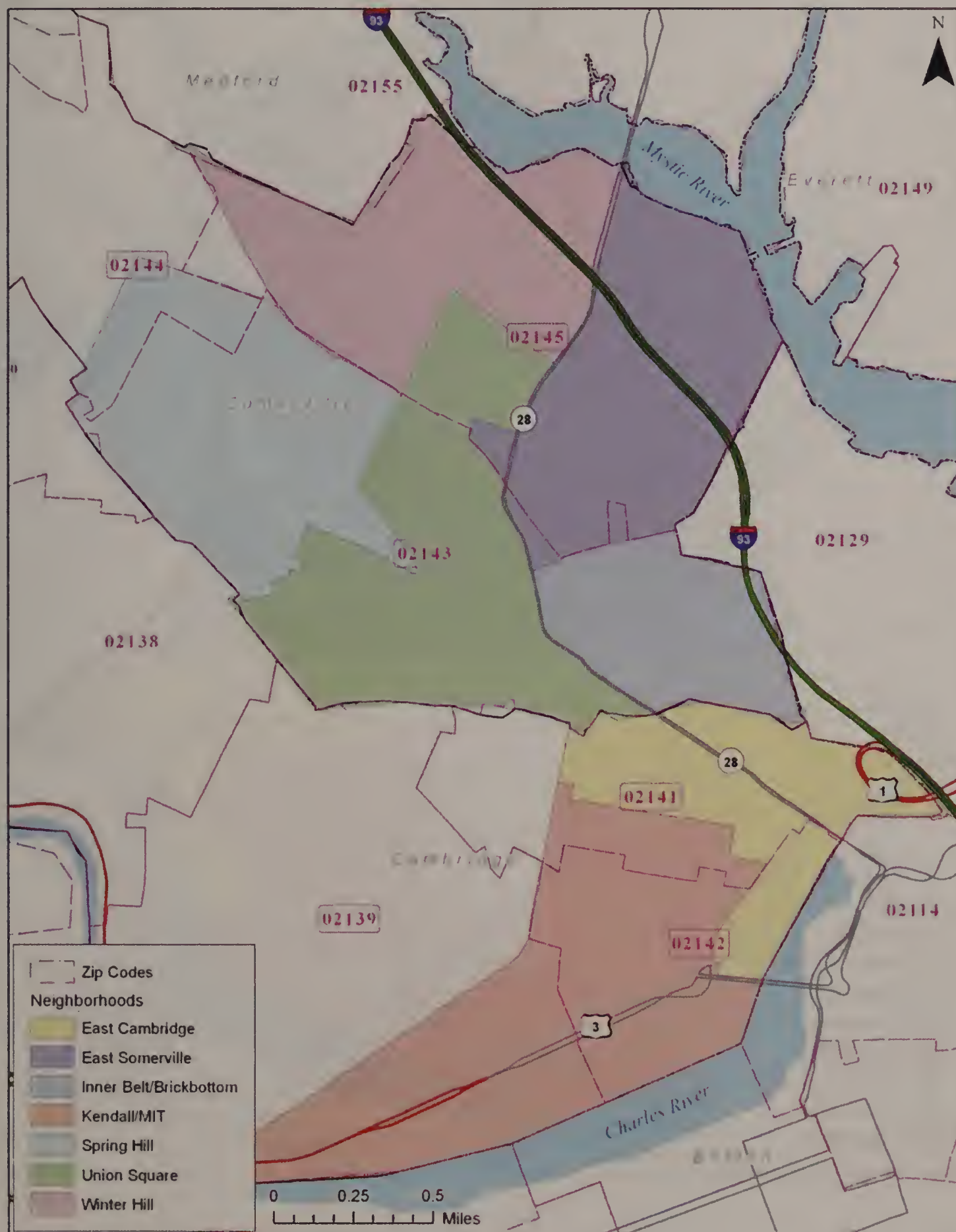


FIGURE 5-N: PILOT HIA STUDY AREA ACCORDING TO NEIGHBORHOODS IN SOMERVILLE, MA





FIGURE 5-O: PILOT HIA STUDY AREA ACCORDING TO TRAFFIC ANALYSIS ZONES (TAZs) IN SOMERVILLE, MA

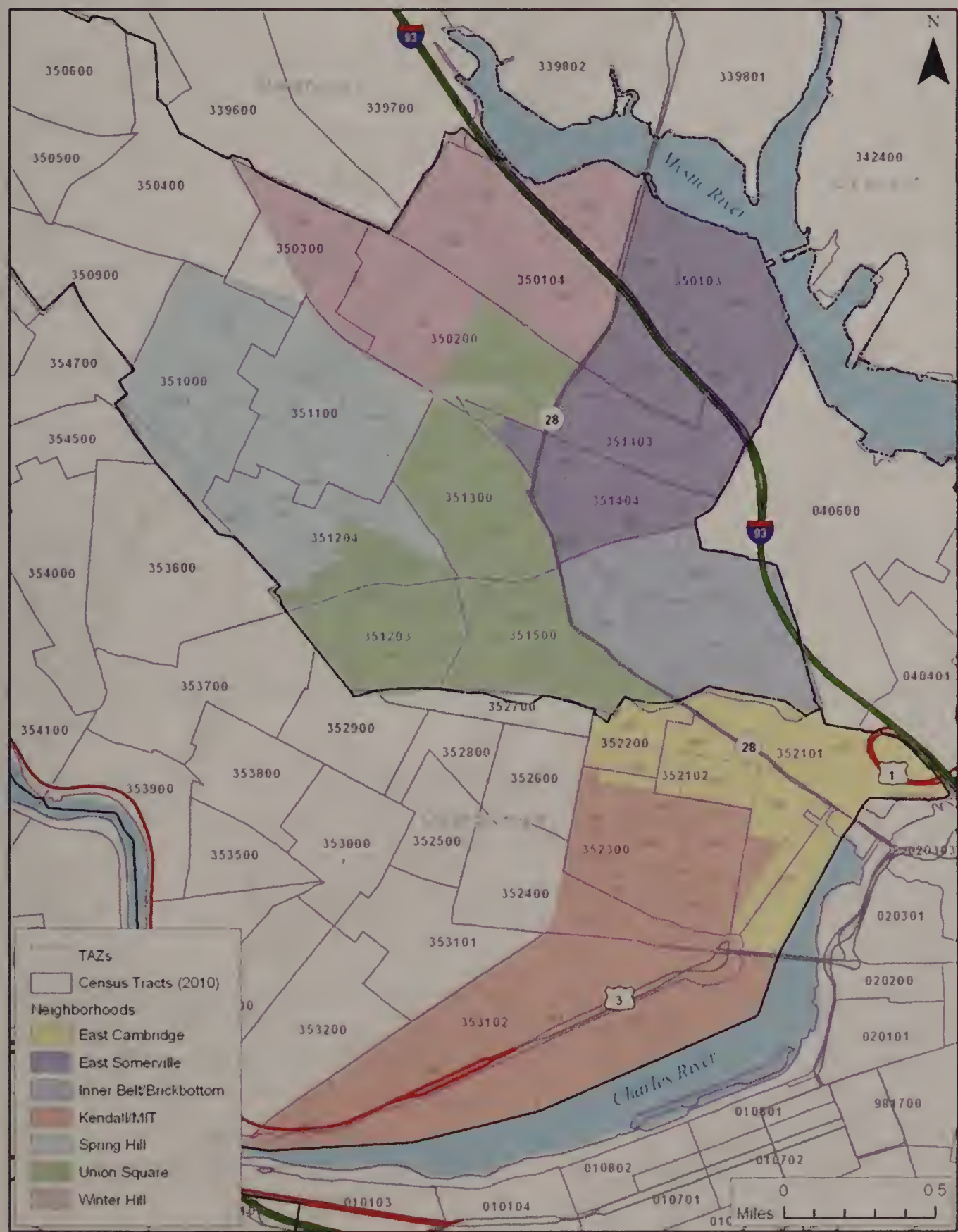




FIGURE 5-P: PATHWAYS EVALUATED IN MASSDOT GM STUDY





## 6. ASSESSMENT

### 6.1. Introduction

The assessment phase of the pilot HIA consists of the following:

- Summary of existing conditions of the study area including demographic and socioeconomic information, determination of vulnerable populations in the study area, and review of baseline health information in the study area
- Assessment of the health impacts according to the analytical plan presented in the scoping section and determination of the significance of these impacts (e.g., direction, magnitude, distribution)
- Limitations and uncertainties in the assessment are also considered.

### 6.2. Summary of 2010 Existing Conditions

#### 6.2.1. Demographics and Socioeconomic Factors

Table 6-1 presents the total population in Somerville based on 2010 Census and the total population projected by the CTPS Travel Demand Model for 2035. The population is expected to increase by approximately 14%.

**TABLE 6-1: POPULATION ESTIMATES AND PROJECTED CHANGE FROM 2010 TO 2035 IN SOMERVILLE, MA**

Year	2010	2035
Total	75,754	88,045

Seven census tracts are located within one-quarter mile of the McGrath Highway. The 2010 Census provided information on median age, median household income, and percent of population of high school graduates, families below poverty level, and unemployment. This information is provided in Table 6-2.

**TABLE 6-2: SELECTED DEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTICS**

Census Tracts	Population 2010	Median Age	Median household income (dollars)	Percent of High school graduate (includes equivalency) or higher	Families with income below poverty level	Unemployment rate, ages 16+
350103	1210	36.6	67,500	87.5%	24.8%	17.0%
350104	7275	31.8	47,231	79.4%	22.7%	6.4%
350200	6567	33.6	59,978	91.7%	5.5%	5.2%
351300	4233	36.2	56,658	91.0%	4.1%	13.4%
351403	4028	33.1	35,453	92.2%	13.2%	3.9%
351404	4289	33.2	40,783	75.5%	16.3%	5.2%
351500	2310	34.5	39,343	66.8%	18.1%	3.5%
Somerville	75,754	31.4	61,731	88.8%	14.7%	6.3%
State	6,547,629	39.1	64,509	88.7%	10.5%	7.4%

Table 6-3 presents the percent of the Somerville population under 5 years of age, less than 18 years of age and 65 years of age and older.

**TABLE 6-3: AGE OF SOMERVILLE POPULATION**

Area	Persons under 5 Years	Persons under 18 years	Persons 65 years and over
350103	6.70%	14.90%	14.50%
350104	6.60%	22.30%	8.10%
350200	5.10%	14.90%	9.20%
351300	5.10%	12.00%	13.20%
351403	5.80%	16.40%	9.70%
351404	6.00%	17.90%	8.40%
351500	4.80%	12.90%	13.70%
Somerville	4.60%	12.10%	9.10%
State	5.60%	21.70%	13.80%



Table 6-4 presents the percentage of population by race and ethnicity.

**TABLE 6-4: RACE AND ETHNICITY OF THE SOMERVILLE RESIDENTS**

Race and Ethnicity	Percentage
Caucasian	73.92%
African American	6.81%
American Indian and Alaskan Native	0.26%
Asian	8.72%
Pacific Islander	0.04%
Other*	10.25%
Latino or Hispanic	10.58%

\*Classified as “some other race” and “two or more races”

Table 6-5 and Table 6-6 present additional socioeconomic factors for Somerville reported in the 2010 Census. There is a 12% higher rate of Somerville residents that were foreign-born or have a language other than English spoken at home compared to the state as a whole. There is a 43% higher rate of multiple housing structures compared to the state as a whole.

**TABLE 6-5: SELECTED SOCIOECONOMIC FACTORS**

2006-2010	Somerville	State
Foreign born persons	26.80%	14.50%
Language other than English spoken at home, percentage age 5+	32.60%	21.00%

**TABLE 6-6: SELECTED HOUSING CHARACTERISTICS AND POPULATION DENSITY**

	<b>Somerville</b>	<b>State</b>
<b>Homeownership rate</b>	33.40%	64.00%
<b>Housing units in multi-unit structures</b>	85.10%	41.70%
<b>Median value of owner-occupied housing units</b>	\$453,800	\$352,300
<b>Households</b>	31,918	2,512,552
<b>Persons per household</b>	2.26	2.48
<b>Persons per square mile (2010)</b>	18,404.80	839.4

Based on data provided by the City of Somerville, there are approximately 18 special needs and five public housing facilities, as well as several public schools located within one-half mile of the McGrath Highway.

Another important socioeconomic factor is employment (See Table 6-7). The CTPS Travel Demand Model also projects a significant increase in employment opportunities in 2035 future scenario.

**TABLE 6-7: FUTURE EMPLOYMENT PROJECTIONS IN SOMERVILLE FROM 2010 TO 2035**

<b>Year</b>	<b>Total</b>	<b>Base</b>	<b>Retail</b>	<b>Service</b>
<b>2010</b>	20,435	4,684	4,276	11,475
<b>2035</b>	35,564	6,951	7,294	21,320

### 6.2.2. Environmental Justice Populations in Somerville, MA

Figure 6-A (page 75) shows census tracts in Somerville meeting one or more of the EEOEA Environmental Justice criteria. The census tracts include:

- 350104
- 350200
- 351300
- 351404
- 351500
- 350300
- 351204
- 351403



Three of the Environmental Justice census tracts cover the immediate McGrath Highway study area (351300, 351404, and 351500). Census tracts 351404 and 351500 meet all four criteria.

### 6.2.3. Baseline Health Data

#### 6.2.3.1. HOSPITALIZATION DATA

Table 6-8 presents 2010 rates of hospitalization for primary diagnoses of asthma, myocardial infarction, congestive heart failure, stroke, hypertension, and diabetes for Massachusetts, the city of Somerville, and the four ZIP code area that surrounds the proposed McGrath highway project. (As noted above, a portion of the zip code area includes Cambridge.) Rates are age-standardized to the age distribution of the state of Massachusetts based on data from the 2010 US Census. For asthma hospitalizations, rates of both inpatient stays and emergency department (ED) visits are presented. Inpatient hospitalizations for asthma can primarily be thought of as the subset of asthma ED visits that resulted in an overnight admission since the large majority of hospital admissions for asthma originated in the ED and are included in the ED rate, as well. The rates of both inpatient and ED asthma hospitalizations among residents of the four-ZIP area under study were slightly lower than those of Massachusetts as a whole. Rates of myocardial infarction, stroke, and diabetes hospitalizations were also somewhat lower for the four-ZIP code study area compared to Massachusetts. Congestive heart failure and hypertension hospitalizations are similar in the study area compared to the state.

**TABLE 6-8: INPATIENT HOSPITALIZATIONS AND EMERGENCY ROOM VISITS IN MA, SOMERVILLE, AND ZIP CODES ABUTTING MCGRATH HIGHWAY (2010)**

Region	INPATIENT HOSPITALIZATIONS <sup>a</sup>						EMERGENCY DEPARTMENT VISITS <sup>d</sup>
	Asthma	Myocardial Infarction <sup>c</sup>	Congestive Heart Failure <sup>c</sup>	Stroke <sup>c</sup>	Hypertension <sup>c</sup>	Diabetes <sup>c</sup>	Asthma
<b>Massachusetts (cases/100,000)</b>	155	358	594	292	121	175	670
<b>Somerville, city (cases/100,000)<sup>b</sup></b>	123	335	686	234	169	179	567
<b>4-ZIP code area (cases/100,000)<sup>b</sup></b>	128	293	608	216	138	159	602

<sup>a</sup>Rates are for primary diagnoses of hospitalizations with an admission date in 2010 for patients with a residential address in MA, Somerville, or select ZIP codes (02141, 02142, 02143, 02145) within the study area. Base population figures for rate calculations came from the 2010 US Census; for ZIP code areas, US Census data for matching zip code tabulation areas (ZCTA) was used.

<sup>b</sup>Age-standardized rates were calculated using 2010 US Census data and were adjusted to the 2010 age distribution of MA in 10 age groups (yrs): 0-4, 5-9, 10-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75+.

<sup>c</sup>Crude and standardized rates of myocardial infarction, congestive heart failure, stroke, and hypertension are restricted to ages 35 and above; rates of diabetes are restricted to ages 15.



<sup>d</sup>Includes outpatient observation stays and inpatient hospitalizations that originated in the ED.

#### 6.2.3.2. LOW BIRTH WEIGHT

Based on information from the Massachusetts Standard Certificate of Live Birth, which is filed with the Registry of Vital Records and Statistics, MDPH calculated birth weight statistics for births to residents of the 7-census tract area surrounding the McGrath Highway study area as well as births to all Massachusetts residents (Table 6-9). In 2007, the area surrounding McGrath Highway had a marginally smaller percentage of low birth weight babies (7.4%), but a slightly higher percentage of very low birth weight babies (1.9%) compared to the state as a whole.

**TABLE 6-9: BIRTH CHARACTERISTICS FOR SELECT CENSUS TRACTS IN SOMERVILLE, MA (2007)**

	Low Birth Weight (<2500 g)	Very Low Birth Weight (<1500 g)
McGrath Highway Area <sup>a</sup>	7.4%	1.9%
Massachusetts	7.9%	1.4%
<sup>a</sup> Includes the following census tracts: 350103, 350104, 350200, 351300, 351403, 351404, 351500.		

#### 6.2.3.3. PEDIATRIC ASTHMA

In addition to evaluating available hospital-based data, MDPH/BEH routinely conducts statewide pediatric asthma surveillance as reported by school nurses and/or administrative staff at public and private schools serving any of grades K-8. These pediatric asthma data were examined for the GM HIA study area. School-based asthma data have been shown to closely reflect doctor-diagnosed asthma, as demonstrated in a study carried out by MDPH/BEH in the Merrimack Valley region of the state which showed 96 percent agreement between the two sources. Data reported by school nurses includes the city or town of residence for each child with asthma, which also enables MDPH/BEH to estimate accurate pediatric asthma prevalence by city/town of residence.

Table 6-10 lists eleven Somerville schools and their 2008-2009 total enrollments, as well as the numbers of students reported to have asthma and the prevalence of asthma in each school. Prevalence data for pediatric asthma are not age-adjusted. Therefore, when comparing prevalence estimates across schools, it is important to note that some of the observed differences in prevalence estimates may partly be due to differences in age distributions at different schools. For the 2008-2009 school year, no school had an asthma prevalence that was statistically significantly higher than the community of Somerville as a whole and one school, John F Kennedy Elementary, had an asthma prevalence rate that was statistically



significantly lower than that of Somerville as a whole. Compared to the state of MA, the prevalence of pediatric asthma was statistically significantly lower in Somerville as a whole. The prevalence of pediatric asthma was also lower in each of the individual schools compared to the statewide rate, though not all differences were statistically significant.

**TABLE 6-10: PEDIATRIC ASTHMA RATES FOR K-8TH GRADE STUDENTS IN SOMERVILLE, MA (2008-2009)**

School Name	Grades Served	Total Asthma Count	Total Enrollment	Prevalence %	Confidence Interval	
					Low	High
Capuano Early Childhood Center	PreK-K	16	172	9.3	5.0	13.6
Benjamin G Brown	K-6	20	255	7.8	4.5	11.1
Arthur D Healey	K-8	47	562	8.4	6.1	10.7
John F Kennedy Elementary	PreK-8	17	460	3.7	2.0	5.4
Albert F. Argenziano School at Lincoln Park	K-8	34	497	6.8	4.6	9.1
East Somerville Community	1-8	36	546	6.6	4.5	8.7
West Somerville Neighborhood	PreK-8	20	323	6.2	3.6	8.8
Winter Hill Community	K-8	20	427	4.7	2.7	6.7
Next Wave Junior High	6-8	NR	20	NR	NR	NR
St Catherine Of Genoa Elementary	K-8	20	200	10.0	5.8	14.2
Tufts Educational Day Care Center	PreK-K	NR	14	NR	NR	NR
<b>SOMERVILLE</b>		286	3,849	7.4	6.6	8.3
<b>STATEWIDE MA</b>		77,353	696,456	11.1	11.0	11.2

\*NR=Not Reported. Due to small numbers, these data are suppressed to protect confidentiality.

#### 6.2.3.4. OBESITY, OVERWEIGHT, AND DEPRESSION IN SOMERVILLE CHILDREN

Data were available for school years 2009-2011 for Somerville students in grades 1, 4, 7, and 10 on rates of obesity and overweight children. For Somerville as a whole, 43.6% of children were overweight or obese. This compares to 32.4 percent statewide for the same year (MDPH 2012).

The BCHAP School Health Services had some information on depression rates in students in Somerville. Then data indicated that approximately 8 in 1,000 Somerville students reported depression versus the state rate of 11.6 per 1,000 students. The fact that significantly more Somerville children are currently obese compared to the statewide average indicates that alternatives that promote health behaviors are paramount.

#### 6.2.3.5. BRFSS DATA

Using data from the Behavioral Risk Factor Surveillance System (BRFSS), a national telephone survey conducted each year by CDC, the MDPH Bureau of Health Information Research Statistics and Evaluation estimated the prevalence of obesity, Type II diabetes, hypertension, and associated risk factors were estimated for Middlesex County residents in 2009 (Middlesex County includes the City of Somerville). As presented in Table 6-11 it is estimated that 20% of Middlesex County adults were obese in 2009, 22% reported ever having hypertension, and 7.5% reported ever having diabetes. With respect to health behaviors in 2009, 16% of Middlesex County adults reported no daily physical activity, but 27% reported eating fruit or vegetables at least five times per day.

**TABLE 6-11: ESTIMATED PREVALENCE OF ADULT OBESITY, HYPERTENSION, TYPE II DIABETES, EXERCISE, AND FRUIT/VEGETABLE INTAKE IN SOMERVILLE, MA (2009)**

	Adult Obesity	Adult Ever Hypertension	Adult Ever Diabetes	Adult No Exercise	Adult Five-A-Day
<b>Middlesex County, MA</b>	20.4%	22.4%	7.5%	16.4%	27.2%
<b>State</b>	21.8%	25.7%	7.9%	20.9%	26.2%

Source: MDPH

#### 6.2.3.6. INJURIES ASSOCIATED WITH TRANSPORTATION IN SOMERVILLE, MA

MassDOT indicates that in 2010, 170 motor vehicle accidents occurred in this area, with 24 injuries and one fatality. According to the MassDOT GM Study, approximately 17% of crashes from 2006-2008 in the study area involved pedestrians or bicyclists.



## 6.3. Assessment of Health Determinants

### 6.3.1. Air Quality

#### 6.3.1.1. AIR QUALITY IMPACTS BASED ON TRAFFIC DENSITY

Available data from CTPS Travel Demand Model on predicted traffic density during peak periods were evaluated as a surrogate for exposure to traffic-related air pollutant emissions for 2010 existing conditions, 2035 No-build, and the four alternatives. Specifically, MDPH/BEH used ArcGIS Inverse Distance Weighting to create traffic density contours based on the 3-hour morning peak periods by traffic analysis zones (TAZ's) expressed as (VMT)/km<sup>2</sup> provided by the CTPS Travel Demand Model. Predicted traffic density along Route 93 was excluded from the traffic density analysis in order to isolate differences in the vicinity of McGrath Highway.

As shown in Figure 6-B (page 76), locations with higher predicted traffic density are consistently located in the area southwest of the McGrath Highway representing higher traffic during peak periods near Union Square in Somerville. Another consistently high traffic density area with steep gradient is shown in the area where Route 28 intersects other major roadways (i.e. Route 16 in Medford). Small differences in predicted traffic density can be seen in the vicinity of Route 28/McGrath Highway from 2010 existing conditions to future years. Although little to no difference in predicted traffic density is apparent among the four future alternatives, predicted traffic density appears highest under the future year 2035 No-build scenario. Thus, based on a review of predicted traffic density in the vicinity of the McGrath Highway during peak periods, the future year 2035 No-build scenario is expected to have a higher air pollution impact than would all four alternatives. No discernible difference between the four alternatives is apparent.

#### 6.3.1.2. PREDICTING AIR POLLUTANT CONCENTRATIONS USING AIR DISPERSION MODELING

##### ***Ambient Air Pollution***

As described previously, air dispersion modeling was used to predict concentrations of NO<sub>x</sub> and PM<sub>2.5</sub> in the vicinity of McGrath Highway. Modeling was conducted for the highest morning one-hour peak period for the 2010 existing conditions and 2035 No-build and the four alternatives. The modeling predicts concentrations of NO<sub>x</sub> and PM<sub>2.5</sub> resulting from emissions of vehicles traveling on McGrath Highway as well as roadways in the immediate vicinity. Air pollution impacts due to other major roadways such as Route 93, were not considered, in order to be able to isolate effects of McGrath Highway including possible future changes.

Figure 6-C (page 77) shows the results of air quality dispersion modeling for NO<sub>x</sub> in the study area for 2010 existing conditions, and 2035 No-build, and the four alternatives. Under all scenarios, predicted concentrations of NO<sub>x</sub> appear to be highest along McGrath Highway, and intersecting major streets such as Washington Street, Medford Street, and Somerville Avenue. Predicted NO<sub>x</sub> concentrations are significantly greater in the 2010 existing conditions. While



modest increases in traffic volume are projected in the future, predicted air concentrations of NO<sub>x</sub> are much lower under the 2035 No-build and all four alternatives due to lower vehicle emissions anticipated with improved technology. Small differences were observed however between the future 2035 No-build and the four alternatives, with the Median U-Turn Hybrid alternative appearing to show the lowest predicted NO<sub>x</sub> impacts. It is important to note that in all scenarios, predicted NO<sub>x</sub> concentrations drop rapidly with distance from roadways.

Similar to the map of predicted NO<sub>x</sub> concentrations, modeled concentrations for PM<sub>2.5</sub> are highest under 2010 existing conditions (Figure 6-D; page 78, for PM<sub>2.5</sub> concentrations). Under all scenarios, the highest predicted air concentrations are located at intersections with high volumes on the cross streets, such as McGrath Highway and Broadway. Small differences are observed for future years (2035 No-build and the four alternatives. Again, as with NO<sub>x</sub> concentrations, the least PM<sub>2.5</sub> impacts are predicted for the U Turn/Rotary alternative. In all situations, predicted PM<sub>2.5</sub> concentrations appear to drop rapidly with distance from the roadways.

For illustrative purposes, Figure 6-E (page 79) provides two sets of maps showing modeled NO<sub>x</sub> and PM<sub>2.5</sub> concentrations predicted from air dispersion modeling together with maps of predicted traffic density based on vehicle miles traveled per square kilometer, for the 2010 existing conditions and for one of the future alternatives (Access Road Linwood Street). Although traffic density data were not available for the entire aerial extent covered by the modeled air pollution maps, areas with higher predicted traffic density are similar to areas showing higher NO<sub>x</sub> and PM<sub>2.5</sub> impacts. Thus, based on this example, it seems feasible that traffic density maps may be used as a screening tool to identify areas that may be more impacted by air pollution for purposes of conducting a transportation-related HIA.

## ***Spatial Evaluation of Predicted Air Pollution Concentrations along McGrath Highway***

### **Near-roadway air quality impacts**

In order to evaluate potential near-roadway exposures, air dispersion modeling results (presented in section 6.3.1.1) of both 1-hour peak NO<sub>x</sub> and PM<sub>2.5</sub> concentrations were evaluated at major intersections and locations 200 meters east and west from each intersection along the McGrath Highway for the 2010 existing conditions, No-build 2035, and the four alternatives. There are approximately 1,600 households within the 200 meter buffer along McGrath Highway Study area. In addition, spatial evaluation of air dispersion concentrations along the bike path, sidewalks and community path proposed in the four alternatives were also evaluated.

In considering potential exposures and health effects associated with the proposed bike path, sidewalk, and community path it is important to note the likelihood of increased exposure due to elevated inhalation rates of those utilizing the paths. According to the EPA's Exposure Factors Handbook (U.S. EPA, 2011), the inhalation rate of an average person performing high intensity exercise is four times greater than during light intensity exercise. Exposure to those



biking or running along the proposed paths is predicted to be considerably higher than exposure associated with less intensive activity (e.g., walking).

With respect to pollutant exposure on and near McGrath Highway, the comparison of overall air pollution concentration data (see Table 6-12) indicate the following:

- For NO<sub>x</sub>, 2010 existing conditions, the overall average concentrations at intersections along McGrath Highway are about three times higher than the concentrations 200 meters east and west of the highway. The concentration for 2035 No-build and alternatives are more than 80% lower than concentrations associated with 2010 existing conditions reflecting significant improvements in motor vehicle emission control technology over the next decade.
- Predicted air pollutant concentrations for NO<sub>x</sub> at 200 meters east and west of the McGrath Highway for the 2035 No-build and alternatives are about 50% less than concentrations at intersections.
- The PM<sub>2.5</sub> air modeling concentrations for 2035 No-build and alternatives were 30% less than concentrations for the 2010 existing conditions; however, the reduction in concentrations at 200 meters east and west of the highway are similar to those predicted for NO<sub>x</sub>.
- The average predicted concentrations of NO<sub>x</sub> and PM<sub>2.5</sub> along the sidewalks, bike path and community path show little variability between the four alternative designs. (These features do not exist in the No-build design.) The predicted NO<sub>x</sub> concentrations range from 30-33 µg/m<sup>3</sup> for the bike path, 23-30 µg/m<sup>3</sup> for the sidewalk. Relatively lower concentrations (17-20 µg/m<sup>3</sup>) are predicted along the community path which is located about one-quarter mile from the sidewalks and bike paths that abut the McGrath Highway. The predicted PM<sub>2.5</sub> concentrations range from 5.6-6.4 µg/m<sup>3</sup> for the bike path, 3.2-3.6 µg/m<sup>3</sup> for the sidewalk, and 4.2-5.7 µg/m<sup>3</sup> for the community path.

**TABLE 6-12: NO<sub>x</sub> AND PM<sub>2.5</sub> CONCENTRATIONS AT MCGRATH HIGHWAY INTERSECTIONS**

	2010 Existing Conditions	No-build	Boulevard	Access	U Turn	Inner Belt
<b>NO<sub>x</sub> Concentrations (µg/m<sup>3</sup>)</b>						
<b>Average Intersection</b>	306.1	50.6	44.2	44.6	44.1	43.1
<b>Average 200M West</b>	138.4	22.9	19.8	20.1	18.9	19.7
<b>Average 200M East</b>	110.7	18.7	17.9	17.0	17.8	17.0
<b>PM<sub>2.5</sub> Concentrations (µg/m<sup>3</sup>)</b>						
<b>Average Intersection</b>	11.5	7.9	6.6	6.8	6.8	6.4
<b>Average 200M West</b>	5.2	3.6	3.0	3.0	2.9	3.0
<b>Average 200M East</b>	3.9	2.8	2.6	2.5	2.6	2.5

Review of traffic density and air quality dispersion modeling results indicate that traffic density information can be a feasible source of information to screen possible impacts of changes in traffic on air quality as a result of transportation projects. Available information indicates that air quality conditions will be improved under any 2035 scenario versus 2010 existing conditions, suggesting that health outcomes associated with poor air quality will also improve. Although air quality does not appear to be very different under any of the future alternatives, the U Turn alternative indicates a greater improvement than the other alternatives or No-build, and thus, may result in the greatest health benefit (e.g., lower respiratory disease outcome/impact). It would also be important to note that by de-elevating the highway and increasing near-roadway walking and biking, exercising individuals would be expected to be exposed to more air pollution than non-exercising individuals, and hence, mitigation steps should be taken to consider reducing opportunities for future exposures to exercising individuals along the new sidewalks and bike path.

### Greenhouse Gases

As part of the air quality assessment, CO<sub>2</sub> emissions for the 2010 existing conditions, 2035 No-build, and the four alternatives were evaluated. CO<sub>2</sub> emissions are an important consideration with respect to climate variability with possible changes in temperature, sea level, and rainfall. Potential health related impacts include heat-related illness, and water-borne, food-borne, vector-borne illnesses.



The CO<sub>2</sub> emissions were provided by the CTPS Travel Demand Model. Results showed that CO<sub>2</sub> emissions under 2010 existing conditions were lower than future conditions (e.g. 2035 No-build 24,011 kg vs. 22,775 kg in 2010 existing conditions). Overall CO<sub>2</sub> emissions in future scenarios are not expected to significantly decrease.

### 6.3.2. Noise

MDPH/BEH conducted a screening analysis to determine the spatial extent of traffic noise in the study area under 2010 existing conditions, 2035 No-build and alternative designs using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM) Version 2.5<sup>1</sup>. Traffic noise was modeled using 1-hour peak traffic volumes at a location that is predicted by the CTPS Travel Demand Model to have the maximum traffic volumes. The modeling domain included a residential area location from Medford Street to Washington Street along the McGrath Highway.

The model considered the effects of the elevated structure and the effects of increased speed across alternatives. Assuming the same traffic volume, the model predicted that noise levels associated with a de-elevated structure are about 2 dB(A) higher compared to noise levels from the elevated structure up to a distance of 450 feet. There were no significant changes in noise levels across the alternative designs.

MDPH/BEH mapped the location of modeled hourly noise levels that exceed the Federal Highway Administration (FHWA) hourly traffic noise guideline of 57 dB(A). Table 6-13 below demonstrates that there is little expected difference in traffic noise levels among the four alternatives. The highest levels of noise (72 dB(A)) are expected to occur at distances of 100 feet or less from the highway.

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<sup>1</sup> Predictive noise modeling with TNM is required for highway projects receiving federal funds on or after May 2, 2005.

**TABLE 6-13: NOISE LEVELS (LA<sub>EQ</sub>1H) ASSOCIATED WITH MAXIMUM 1-HOUR MORNING PEAK TRAFFIC VOLUME FOR 2010 EXISTING CONDITIONS, 2035 NO-BUILD AND THE ALTERNATIVES**

	2010 Existing Conditions		2035 No-build	Inner Belt	Boulevard	Access	U Turn	Inner Belt
AM or PM Peak Hour	AM	PM	AM	AM	AM	AM	AM	AM
Elevated or at Grade	Elevated	Elevated	Elevated	Not Elevated	Not Elevated	Not Elevated	Not Elevated	Not Elevated
Speed (mph)	35	45	35	35	35	35	35	35
Distance (feet)								
50	69.2	68.2	69.6	73.2	73.1	73.1	73.2	73.5
100	66.7	67.3	67.1	68.9	68.8	68.9	68.9	69.2
150	65.0	65.7	65.4	66.7	66.7	66.7	66.7	67.0
200	63.9	64.9	64.3	65.2	65.1	65.1	65.2	65.5
250	63.0	64.0	63.4	63.9	63.8	63.8	63.9	64.2
300	62.2	63.2	62.6	62.9	62.8	62.7	62.9	63.1
350	61.5	62.5	61.9	61.9	61.8	61.7	61.9	62.2
400	60.8	61.8	61.2	61.0	60.9	60.8	61.0	61.3
450	60.2	61.2	60.5	60.2	60.1	60.0	60.2	60.5
500	59.5	60.6	59.9	59.4	59.3	59.3	59.4	59.7
550	58.9	60.0	59.3	58.7	58.6	58.6	58.7	59.0
600	58.6	59.6	59.0	58.0	57.9	57.9	58.0	58.3
650	58.0	59.1	58.4	57.4	57.3	57.2	57.4	57.7
700	57.5	58.5	57.8	56.8	56.7	56.6	56.8	57.1
750	56.9	58.0	57.3	56.2	56.1	56.1	56.2	56.5
800	56.4	57.5	56.8	55.7	55.6	55.5	55.7	56.0
850	55.9	57.0	56.3	55.1	55.0	55.0	55.1	55.4
900	55.4	56.5	55.8	54.6	54.5	54.5	54.6	54.9
950	55.0	56.1	55.4	54.2	54.1	54.0	54.2	54.5
1000	54.5	55.6	54.9	53.7	53.6	53.5	53.7	54.0



Modeling of noise for the 2035 No-Build and alternatives indicates that de-elevation of the highway would result in small noise increases, with declining levels as distance from the highway increases. Noise differences between existing versus future alternatives appear to be small (about 2 dB(A) or less), but noise levels remain slightly higher than current recommended federal guidelines for all future alternatives closer to the highway. As a result, we would not expect a notable difference with respect to health outcomes associated with noise, such as fatigue associated with sleep disturbance, mental health aspects (e.g., annoyance), or effects on educational learning when considering 2010 existing conditions, 2035 No-build or any of the alternatives.

### **6.3.3. Mobility and Connectivity**

#### **6.3.3.1. ASSESSMENT OF WALKING AND BIKING CAPACITY**

The Pedestrian Environmental Quality Index (PEQI) and Bicycle Environmental Quality Index (BEQI) tools were used to evaluate the capacity of 2010 existing conditions and alternative designs to encourage walking and biking in the McGrath Highway study area. These observational survey tools were developed by the San Francisco Department of Public Health (SFDPH). The PEQI and BEQI assess the quality of the physical pedestrian and bicycling environment using a formula for scoring each road and intersection based on their features.

The PEQI and BEQI features are grouped into five main categories known to affect people's travel behaviors: intersection safety, traffic, street design, land use and perceived safety. There are many features evaluated in the PEQI and BEQI including: traffic calming features (chicanes, medians, speed hump/bump), marked crosswalks, sidewalk impediments, driveway cuts, tree coverage, and pedestrian scale lighting. It should be noted that many of these factors are included as indicators in the MassDOT Grounding McGrath Study evaluation criteria.

The study area for this assessment includes McGrath Highway and streets located approximately two blocks east and west of the highway. The total PEQI and BEQI score is created for each roadway, intersection, sidewalk, or path in the study area. The PEQI or BEQI score reflects the quality of the pedestrian/bicycling environment on a 0 to 100 scale. For both BEQI and PEQI the categories of scores developed by SFDPH are:

- 0-20                Environment not suitable to pedestrians/bicyclists
- 21-40             Poor pedestrian/bicyclist conditions exist
- 41-60             Basic pedestrian/bicyclist conditions exist
- 61-80             Reasonable pedestrian/bicyclist conditions exist, and
- 81-100            Ideal pedestrian/bicyclist conditions exist

Although the detailed designs of the alternatives have not been developed at this stage of the MassDOT GM Study, it is MDPH/BEH's understanding that the future pedestrian and bicycling networks for each of the four alternatives will conform to Complete Streets guidelines, which require the incorporation of the highest quality design elements associated with active

transportation. Thus, the PEQI and BEQI scores for each of the four alternative designs are assumed to fall within the highest category indicating ideal conditions for walking and biking.

### ***PEQI Scores for 2010 Existing Condition and Alternatives***

The PEQI score quantifies street and intersection factors empirically known to affect pedestrian's travel behaviors. Factors include presence of sidewalk, width of sidewalk, public seating, public art, illegal graffiti and litter, empty spaces (vacant lots, abandoned lots, parking lots), pedestrian refuge islands, curb cuts at crossings, and pedestrian signals. Figure 6-F (page 80) presents the PEQI scores for streets and intersections in the study area according to 2010 existing conditions. The map also identified the locations of the future sidewalks and community path. Under 2010 existing conditions, the McGrath Highway receives a PEQI score between 0 and 40, which indicates that it is not suitable for pedestrians or that poor pedestrian conditions exist. The streets within a two-block area of the McGrath Highway score between 21 and 60, indicating poor to basic pedestrian conditions.

Figure 6-G (page 81) provides the aggregate PEQI scores for the future sidewalks and intersections proposed in the alternative designs. As shown, based on the information currently available, all four designs are anticipated to conform to Complete Streets guidelines and therefore all four alternatives fall within the highest PEQI category.

### ***BEQI Scores of Existing Features***

The BEQI provides scores for 22 empirically-based indicators, each of which has been shown to promote or discourage bicycle riding and connectivity to other modes of transport. Factors considered in BEQI are: left turn bike lane, no turn on red signal, presence of marked bike route, width of bike route, bike route adjacent to parallel parking, bike route adjacent to sidewalk/curb, connectivity of bike lane, presence of bike lane signs, bike parking, and dashed intersection bike lane.

Figure 6-H (page 82) presents the BEQI score for McGrath Highway and nearby streets under 2010 existing conditions and alternatives (Figure 6-I; page 83). The McGrath Highway BEQI score is in the range of 0 and 20, indicating that it is not suitable for bicyclists. The streets located within the two-block area of the McGrath Highway fall within the range of 0 and 40. Thus, the quality of the streets in the study area ranges from being unsuitable for bicyclists to poor bicycling conditions.

All four alternative designs were scored based on the understanding that they feature a bike path along the eastern border of the McGrath Highway, and biking along the community path. As discussed above, it is MDPH/BEH's that the highest level of design will be incorporated into the bike path and community path to ensure safe bicycling conditions. Thus, under all four alternatives, the bike path and community path are given the highest scoring category in the BEQI.



#### 6.3.3.2. POTENTIAL FOR INCREASED PHYSICAL ACTIVITY THROUGH SHIFTS IN TRAVEL MODE

The HIA evaluated the potential for increased physical activity through predicted shifts in travel mode (e.g., from auto to walking/biking) and increased connectivity to public transit and nearby areas (e.g., Union Square).

The evaluation required the following data: (1) routes to assess mode shift (from auto to walk/bike) in 2010 existing conditions and 2035 No-build and alternatives and (2) mode shift data from CTPS Travel Demand Model.

Two paths in the study area that were evaluated in the MassDOT GM Study were selected for assessing potential increase in physical activity: Washington Street from Maffa Way to Union Square and Medford Street and McGrath Highway from School Street to Rufo Street (see Figure 6-J; page 84).

Mode share for auto, transit and walk/bike for Washington Street is based on mode shift data from aggregated TAZs for the Inner Belt/Brickbottom neighborhood. Milford Street is assigned mode share data from East Somerville. The CTPS Travel Demand Modeling data for the Inner Belt/Brickbottom area predicts that on a typical morning in 2035 about 31% of the people leaving the Inner Belt/Brickbottom neighborhood will choose to walk/bike whereas most of (74%) the people going to Inner Belt/Brickbottom neighborhood will be arriving by auto. During the evening commute, 19% of people are predicted to be leaving Inner Belt by walk/bike whereas 38% of the commuters are arriving to this neighborhood by walking/biking. In East Somerville, the number of people who walk/bike is similar to Inner Belt/Brickbottom except that 18% of the evening commuters to East Somerville are predicted to choose to walk/bike.

The potential for increased physical activity by shifting from auto to walk/bike along the two routes described above (i.e., along Washington Street and Medford Street) has been estimated using the following factors:

- 20 minute/mile brisk walking is associated with moderate intensity aerobic exercise (Warburton et al., 2006)
- The physical inactivity index for Massachusetts is defined as less than 30 minutes of moderate physical activity most, if not all, days of the week (Chenoweth et al., 2006).

The evaluation of physical activity (Table 6-14) associated with mode shift from auto to walk/bike along two routes evaluated in the MassDOT GM Study indicates that the physical activity recommendation of 30 minutes of moderate exercise per day would be achieved.

**TABLE 6-14: DATA USED TO EVALUATE SHIFT IN TRAVEL MODE**

<b>ROUTES</b>	<b>Washington Street</b>	<b>Medford Street and McGrath Highway</b>
<b>CTPS TDM Mode shift data</b>	Inner belt	East Somerville
<b>Length miles</b>	1.1	1.3
<b>Estimated minutes of walking along route based on 20 min/mile</b>	22 minutes/2 times day = 44 minutes	26 minutes/2 times day = 52 minutes
<b>Meets with physical activity recommendation of 30 min of moderate exercise</b>	Yes	Yes

Based on future plans to significantly enhance the walkability and bikeability of the McGrath Highway area, along with the planned Green Line extension, we would expect significant improvements in health measures associated with increasing exercise, such as obesity, Type II diabetes, and cardiovascular disease outcomes. We would also expect improved mental health indicators with improved access to other regional destinations and associated activities. Review of available information suggests little difference between the four alternative designs in mobility and connectivity determinants, but all alternatives are more optimal than the 2035 No-build.

#### **6.3.4. Public Safety**

##### **6.3.4.1. CURRENT CRASH RATES AND ACCIDENT STATISTICS**

The Massachusetts fatality rate (0.58 fatalities per 100 million miles driven is 53% of the national average of 1.10 (NHTSA, 2012). According to the MassDOT, there were approximately 170 auto accidents along the McGrath corridor in 2010, 24 injuries associated with these crashes and one fatal crash. The accident data is a compilation of accident reports submitted to the Registry of Motor Vehicles (RMV) from local, state, and public transportation police departments as well as from residents. According to analysis reported in the MassDOT GM Study, intersections with Broadway, Washington, and Somerville Avenue/Poplar Street exceed average crash rates. In addition, approximately 17% of the reported crashes from 2006-2008 involved pedestrians or cyclists. The remaining study area intersections experienced crash rates below the statewide and regional averages, indicating no significant safety deficiencies at the study area intersections.

##### **6.3.4.2. FUTURE INJURIES AND FATALITIES**

Public safety is assessed by evaluating injuries and fatalities that are related to higher traffic volume. Traffic volume is quantified for a given area by vehicle miles traveled (VMT), VMT per capita, and travel volume. For the analysis of public safety conditions associated with 2010



existing conditions, 2035 No-build and alternative designs, VMT and travel time data from the CTPS Travel Demand Model were used to estimate conditions in the future.

As noted above, the average Massachusetts fatality rate is 0.58 fatalities per 100 million miles driven. According to US DOT, the US average injury rate is 75 injuries per 100 million miles driven. The table below (Table 6-15) summarizes predicted fatalities and injuries in the immediate McGrath Highway area for an annualized 3-hour morning peak period using US DOT fatality and injury rates for 2010 existing conditions, 2035 No-build and the four alternatives.

**TABLE 6-15: VMT AND PREDICTED FATALITIES AND INJURIES ASSOCIATED WITH MCGRATH HIGHWAY, 2010 EXISTING CONDITIONS, 2035 NO-BUILD AND ALTERNATIVES**

Alternative	VMT-Peak Hour	VMT 3-Hour AM Rush	Annualized 3-Hour AM	Fatalities-0.58 per 100 Million Miles	Injuries-75 per 100 Million Miles
<b>2010 Existing Conditions</b>	16,366	40,915	12,274,500	0.07	9.21
<b>2035 No-build</b>	18,526	46,315	13,894,500	0.08	10.42
<b>Boulevard</b>	16,868	42,170	12,651,000	0.07	9.49
<b>Access</b>	17,005	42,513	12,753,750	0.07	9.57
<b>U Turn</b>	16,977	42,443	12,732,750	0.07	9.55
<b>Inner Belt</b>	16,871	42,178	12,653,250	0.07	9.49

These data indicate that there will be an increase in traffic from 2010 existing conditions to 2035 due to population and economic growth. However, VMT is expected to be lower for all alternatives compared to 2035 No-build. Based solely on average fatality and injury rates, small increases in fatalities and injuries could be expected. Safer roadway design with the alternatives would likely mitigate possible increases in fatalities and injuries.

#### 6.3.4.3. SAFETY CONSIDERATIONS BASED UPON TRAVEL TIMES

McGrath Highway is an important regional link to Boston and area hospitals. Travel time during both average and congested conditions is an important consideration, particularly in regard to travel times for public safety vehicles.

The CTPS Travel Demand Model provided travel time during average conditions, as well as during congested conditions. Table 6-16 summarizes the average and congested travel times along a southbound section of McGrath Highway in the study area for existing, 2035 No-build and the four alternatives. It should be noted that these data do not include delays at intersections because the data were not available from the MassDOT GM Study. The travel

time public safety vehicles for all alternatives could result in delay of more than one minute over 2010 existing conditions on the McGrath Highway.

**TABLE 6-16: TRAVEL TIME ALONG MCGRATH HIGHWAY FOR 2010 EXISTING CONDITIONS, 2035 NO-BUILD AND EACH ALTERNATIVE**

	Average Travel Time	Congested Travel Time	Distance (miles)
<b>2010 Existing Conditions</b>	3.06	4.47	1.66
<b>2035 No-build</b>	3.09	4.91	1.66
<b>Boulevard</b>	4.39	5.65	1.65
<b>Access</b>	4.23	5.56	1.65
<b>U Turn</b>	4.23	5.49	1.65
<b>Innerbelt</b>	4.39	5.58	1.65

Review of available data suggest that future alternatives would not have a significant impact on injuries or fatalities associated with accidents in the McGrath Highway area. It would be important to consider this information for possible mitigation strategies in the alternative designs to address public safety issues. De-elevation might cause slight delays in public safety vehicles moving through the area, another factor to consider in final design considerations.

### **6.3.5. Land Use and Economic Development**

#### **6.3.5.1. ACCESS TO GOODS AND SERVICES**

Due to limited data on land use and economic development associated with the alternative designs at this stage of the Grounding McGrath Study, the HIA assessed access to multiple goods and services and green space by determining the number of people living within one-half mile of goods and services in the study area and the potential increase in connectivity across McGrath Highway that may be associated with alternative design features.

A map of the location of goods and services in the study area is presented in Figure 6-K (page 85). Of the total of 832 goods and services located throughout Somerville, approximately 101 are located within one-quarter mile of McGrath Highway. Figure 6-K (page 85) illustrates the wide range of goods and services. Of the three neighborhoods within the one-quarter mile area in the HIA analysis (i.e., Union Square, Inner Belt/Brickbottom and East Somerville) about 70% of existing goods and services are located in Union Square.

Figure 6-L (page 83) shows the location of several 'clusters' of goods and services within the one-quarter mile HIA analysis area. The number of households within one-half mile of each



cluster is shown. Spatial analysis of the proximity of households to existing goods and services indicates that there are approximately 8000 households within one-half mile of walking distance of more than 5 goods and services. The Union Square neighborhood has the greatest proximity to goods and services.

There are also currently a number of parks within the “access” study area Figure 6-K (page 85). Access to goods and services and green space, including parks, from one side of McGrath Highway to the other is dependent upon ease of crossing, either by foot, bike, or vehicle provides the key features of alternatives that may increase access to goods and services and green space from current conditions. Currently access from one side of McGrath Highway to the other is poor due to limited crosswalks and few streets that cross from one side to the other. Table 6-17, extracted from the Grounding McGrath Study summarizes some key features that illustrate how access will generally improve with all of the alternatives over 2010 existing conditions, with one or two alternatives providing better access than the others (i.e. Boulevard Road Diet and Inner Belt). Based on the available data (number of crosswalks and walks at grade), ease of crossing McGrath Highway either by foot, bike, or motor vehicle, particularly for those who live in East Somerville with fewer available goods and services, will be enhanced most by the Boulevard Road Diet and Innerbelt Alternative. Given that this is an environmental justice area, consideration to promoting culturally appealing goods and services should be given.

Table 6-17 also shows average distance to open space. Approximately two acres of new green space will be added in this project. All four alternatives show significantly better access to green space compared to existing or 2035 No-build conditions. Of the four alternatives, the Median U-Turn Hybrid Rotary alternative has the greatest distance to green space.

The assessment also needs to consider planned development of the Inner Belt/Brickbottom area, as well as the fact that the MBTA Green Line Extension will be operational. There are approximately 14000 households within a half-mile of the new transit stop. In additions, the community path will be extended east of McGrath Highway. When these three initiatives are completed and fully operational it will be even more important that the future McGrath Highway enhance mobility in and around the highway, further economic development opportunities.

An example of improved access to goods and services is to evaluate the ability to walk to school by crossing McGrath Highway. Living near schools promotes increased physical activity (see Figure 6-M; page 87). McDonald 2008 reports that living within a half-mile of a school greatly increases the likelihood of walking or biking to that school across all racial groups. Various studies report the benefits of active commuting to school in that it can provide a substantial portion of children’s physical activity and has been associated with increasing levels of independence, social interaction and communication (Tudor-Locke et al. 2002, Davison et al. 2008, Merom et al. 2006, Leyden 2003, and Poortinga 2006).

**TABLE 6-17: KEY FEATURES AND ATTRIBUTES OF THE 2010 EXISTING CONDITIONS, 2035 NO-BUILD, AND THE FOUR ALTERNATIVES**

	<b>2010 Existing Conditions</b>	<b>2035 No- build</b>	<b>Boulevard</b>	<b>Access</b>	<b>U Turn/ Innerbelt</b>	<b>Innerbelt</b>
<b>Number of Cross Walks That Cross Corridor</b>	7	7	9	6	7	9
<b>Average Block Length</b>	505	505	497	516	478	497
<b>Count of Streets That Cross McGrath at Grade</b>	4	4	6	4	4	6
<b>Average Pedestrian McGrath Crossing Width</b>	85	85	77	77	91	77
<b>Average Distance to Open Space</b>	965	965	156	162	323	156
<b>Average Number of Travel or Turn Lanes in 2 Sections</b>	4.0	4.0	6.0	6.5	7.0	6.0
<b>50th Percentile Traffic Queue Length</b>	N/A	195.6	212.4	94.0	108.4	136.3
<b>90th Percentile Traffic Queue Length</b>	N/A	261.7	270.9	158.9	161.4	182.1
<b>Average of AM and PM Peak Period Speeds Major Roads</b>	N/A	19.5	17.9	18.0	18.0	18.0
<b>Total AM VMT in the Study Area</b>	16,366	18,526	16,868	17,005	16,977	16,871
<b>Total NOx Emissions in Immediate Study Area (grams)</b>	48,198	8,153	7,629	7,693	7,659	7,586
<b>Total PM<sub>2.5</sub> Emissions (grams)</b>	1,125	583	531	536	535	531

The MassDOT GM Study and this HIA assume that future development of the area around the McGrath Highway, along with the operation of the Green Line extension, will greatly increase the availability and accessibility of goods and services in the area. This in turn will likely increase employment rates presumably for local residents, as projected in the MassDOT GM Study. In addition, access to green space will increase. All of these improvements should



result in better overall health, social cohesion, and mental health indicators, with a greater sense of connection to the neighborhood and its goods and services. While these efforts will likely have a significant benefit to this neighborhood, the potential for gentrification is high. For that reason, future plans should consider significant community involvement such that current residents might best benefit.

A summary of these features for each of the alternatives is provided in Table 6-17:

## 6.4. Overall Assessment

Table 6-18 through Table 6-22 summarize the overall impacts overall impacts of the 2010 existing conditions, 2035 No-build and four alternatives for each health determinant. While four alternatives would likely result in improvements for all factors considered in the HIA, the Boulevard Road Diet and Innerbelt Alternative offer the greatest opportunities for mobility and access. The Median U- Turn alternative appears most optimal in terms of air quality but is limited in terms of promoting active transportation and related health benefits. In reducing impacts and terms of health care costs, the benefits associated with each alternative should be considered

The following provides a key describing the qualitative criteria to assess impacts:

**Abbreviations:** *Boulevard* = Boulevard Road Diet; *Access* = Access Road Linwood Street; *U-Turn* = Median U-Turn Rotary Hybrid;

**Impact** refers to whether the alternative will improve (+), harm (-), or not impact health (~).

**Magnitude** reflects a qualitative judgment of the size of the anticipated change in health effect (e.g., the increase in the number of cases of disease, injury, adverse events): Negligible, Minor, Moderate, Major.

**Severity** reflects the nature of the effect on function and life-expectancy and its permanence: High = intense/severe; Mod = Moderate; Low = not intense or severe.

**Strength of Causal Evidence** refers to the strength of the research/evidence showing causal relationship between mobility and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = high degree of confidence in causal relationship. A causal effect means that the effect is likely to occur, irrespective of the magnitude and severity.

Reference: Human Impact Partners, 2011

TABLE 6-18: OVERALL HEALTH ASSESSMENT OF AIR QUALITY

AIR QUALITY					
2010 Existing Conditions, 2035 No-build and Alternative	Impacts of Alternatives		Health Outcome		Limitations / Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Chronic and acute impacts including asthma/other respiratory diseases Cardiovascular impacts (heart attack, CVD)					
2010 Existing	-	Major	High	◆◆◆	Substantial reductions in emissions from 2010 to 2035 for all alternatives. Risks cannot be quantified based on current data.
2035 No-build	+	Major	High	◆◆◆	
Boulevard	+	Major	High	◆◆◆	
Access	+	Major	High	◆◆◆	
U-Turn	+	Major	High	◆◆◆	
Innerbelt	+	Major	High	◆◆◆	
Impacts from greenhouse gas emissions on air quality					
2010 Existing	-	Minor	Moderate	◆◆◆	Direct impacts by increasing some pollutants. Indirect impact on health by contributing to overall CO2 burden. No major changes expected across alternatives
2035 No-build	-	Minor	Moderate	◆◆◆	
Boulevard	-	Minor	Moderate	◆◆◆	
Access	-	Minor	Moderate	◆◆◆	
U-Turn	-	Minor	Moderate	◆◆◆	
Innerbelt	-	Minor	Moderate	◆◆◆	
Mental illness (e.g., interference with cognitive abilities and well-being)					
2010 Existing	-	Moderate	Moderate	◆◆	Research indicates that air pollution may damage children's cognitive abilities, increase adults' risk of cognitive decline and possibly even contribute to depression
2035 No-build	-	Moderate	Moderate	◆◆	
Boulevard	-	Moderate	Moderate	◆◆	
Access	-	Moderate	Moderate	◆◆	
U-Turn	-	Moderate	Moderate	◆◆	
Innerbelt	-	Moderate	Moderate	◆◆	



TABLE 6-19: OVERALL HEALTH ASSESSMENT FOR NOISE

NOISE					
2010 Existing Conditions, 2035 No-build and Alternative	Impacts of Alternatives		Health Outcome		Limitations/ Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Impacts include hypertension, cardiovascular disease					
2010 Existing	-	Moderate	Moderate	◆◆◆	Analysis of area expected to have highest number of vehicles
2035 No-build	-	Moderate	Moderate	◆◆◆	
Boulevard	-	Moderate	Moderate	◆◆◆	
Access	-	Moderate	Moderate	◆◆◆	
U-Turn	-	Moderate	Moderate	◆◆◆	
Innerbelt	-	Moderate	Moderate	◆◆◆	
Mental illness (e.g., interference with cognitive abilities, well-being due to sleep disturbance)					
2010 Existing	-	Moderate	Moderate	◆	
2035 No-build	-	Moderate	Moderate	◆	
Boulevard	-	Moderate	Moderate	◆	
Access	-	Moderate	Moderate	◆	
U-Turn	-	Moderate	Moderate	◆	
Innerbelt	-	Moderate	Moderate	◆	

TABLE 6-20: OVERALL HEALTH ASSESSMENT FOR MOBILITY AND CONNECTIVITY

MOBILITY AND CONNECTIVITY					
2010 Existing Conditions, 2035 No-build and Alternative	Impacts of Alternatives		Health Outcome		Limitations / Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
All-cause and cardiovascular-related deaths					
2010 Existing	-	Major	High	◆◆◆	Compared to 2035 No-build, all alternative provide significant opportunities to increase physical exercise; however, near-road air quality impact need to be mitigated
2035 No-build	-	Major	High	◆◆◆	
Boulevard	+	Major	High	◆◆◆	
Access	+	Major	High	◆◆◆	
U-Turn	+	Major	High	◆◆◆	
Innerbelt	+	Major	High	◆◆◆	
Cardiovascular diseases (e.g., coronary artery disease, hypertension)					
2010 Existing	-	Major	High	◆◆◆	
2035 No-build	-	Major	High	◆◆◆	
Boulevard	+	Major	High	◆◆◆	
Access	+	Major	High	◆◆◆	
U-Turn	+	Major	High	◆◆◆	
Innerbelt	+	Major	High	◆◆◆	
Mental illness (e.g., depression, well-being)					
2010 Existing	-	Major	High	◆◆◆	
2035 No-build	-	Major	High	◆◆◆	
Boulevard	+	Major	High	◆◆◆	
Access	+	Major	High	◆◆◆	
U-Turn	+	Major	High	◆◆◆	
Innerbelt	+	Major	High	◆◆◆	
Obesity and Type II diabetes					
2010 Existing	-	Major	High	◆◆◆	
2035 No-build	-	Major	High	◆◆◆	
Boulevard	+	Major	High	◆◆◆	
Access	+	Major	High	◆◆◆	
U-Turn	+	Major	High	◆◆◆	
Innerbelt	+	Major	High	◆◆◆	



TABLE 6-21: OVERALL HEALTH ASSESSMENT FOR PUBLIC SAFETY

PUBLIC SAFETY					
2010 Existing Conditions, 2035 No-build and Alternative	Impacts of Alternatives		Health Outcome		Limitations/ Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Traffic-related injuries and fatalities					
2010 Existing	-	Moderate	Moderate	◆◆◆	Improvements predicted from lower speeds and safer roadway designs. Increases due to increase in access to sidewalks and bike path.
2035 No-build	-	Moderate	Moderate	◆◆◆	
Boulevard	+	Moderate	Moderate	◆◆◆	
Access	+	Moderate	Moderate	◆◆◆	
U-Turn	+	Moderate	Moderate	◆◆◆	
Innerbelt	+	Moderate	Moderate	◆◆◆	
Travel Time Affecting Public Safety Vehicles					
2010 Existing	+	Moderate	Moderate	◆◆	Reduced travel time from potential congestion. Does not include congestion at intersections
2035 No-build	-	Moderate	Moderate	◆◆	
Boulevard	-	Moderate	Moderate	◆◆	
Access	-	Moderate	Moderate	◆◆	
U-Turn	-	Moderate	Moderate	◆◆	
Innerbelt	-	Moderate	Moderate	◆◆	
Mental illness (e.g., stress and well-being)					
2010 Existing	-	Moderate	Moderate	◆◆	
2035 No-build	+	Moderate	Moderate	◆◆	
Boulevard	+	Moderate	Moderate	◆◆	
Access	+	Moderate	Moderate	◆◆	
U-Turn	+	Moderate	Moderate	◆◆	
Innerbelt	+	Moderate	Moderate	◆◆	

**TABLE 6-22: OVERALL HEALTH ASSESSMENT FOR LAND USE AND ECONOMIC DEVELOPMENT**

LAND USE AND ECONOMIC DEVELOPMENT					
2010 Existing Conditions, 2035 No-build and Alternative	Impacts of Alternatives		Health Outcome		Limitations/ Uncertainties
	Impact	Magnitude	Severity	Strength of Causal Evidence	
Chronic diseases					
2010 Existing	-	Major	Moderate	♦ ♦	Limited data on land use and economic development associated with alternative designs
2035 No-build	+	Major	Moderate	♦ ♦	
Boulevard	+	Major	Moderate	♦ ♦	
Access	+	Major	Moderate	♦ ♦	
U-Turn	+	Major	Moderate	♦ ♦	
Innerbelt	+	Major	Moderate	♦ ♦	
Social determinants of health (e.g., income, education) and social cohesion					
2010 Existing	-	Moderate	Moderate	♦ ♦	
2035 No-build	+	Moderate	Moderate	♦ ♦	
Boulevard	+	Moderate	Moderate	♦ ♦	
Access	+	Moderate	Moderate	♦ ♦	
U-Turn	+	Moderate	Moderate	♦ ♦	
Innerbelt	+	Moderate	Moderate	♦ ♦	
Mental illness (e.g., interference with cognitive abilities and well-being)					
2010 Existing	-	Moderate	Moderate	♦	
2035 No-build	+	Moderate	Moderate	♦	
Boulevard	+	Moderate	Moderate	♦	
Access	+	Moderate	Moderate	♦	
U-Turn	+	Moderate	Moderate	♦	
Innerbelt	+	Moderate	Moderate	♦	



## 6.5. Figures

**FIGURE 6-A: CENSUS TRACTS IN SOMERVILLE MEETING ONE OR MORE OF EOEEA'S ENVIRONMENTAL JUSTICE CRITERIA**



FIGURE 6-B: PREDICTED TRAFFIC DENSITY DURING MORNING PEAK TRAFFIC PERIOD

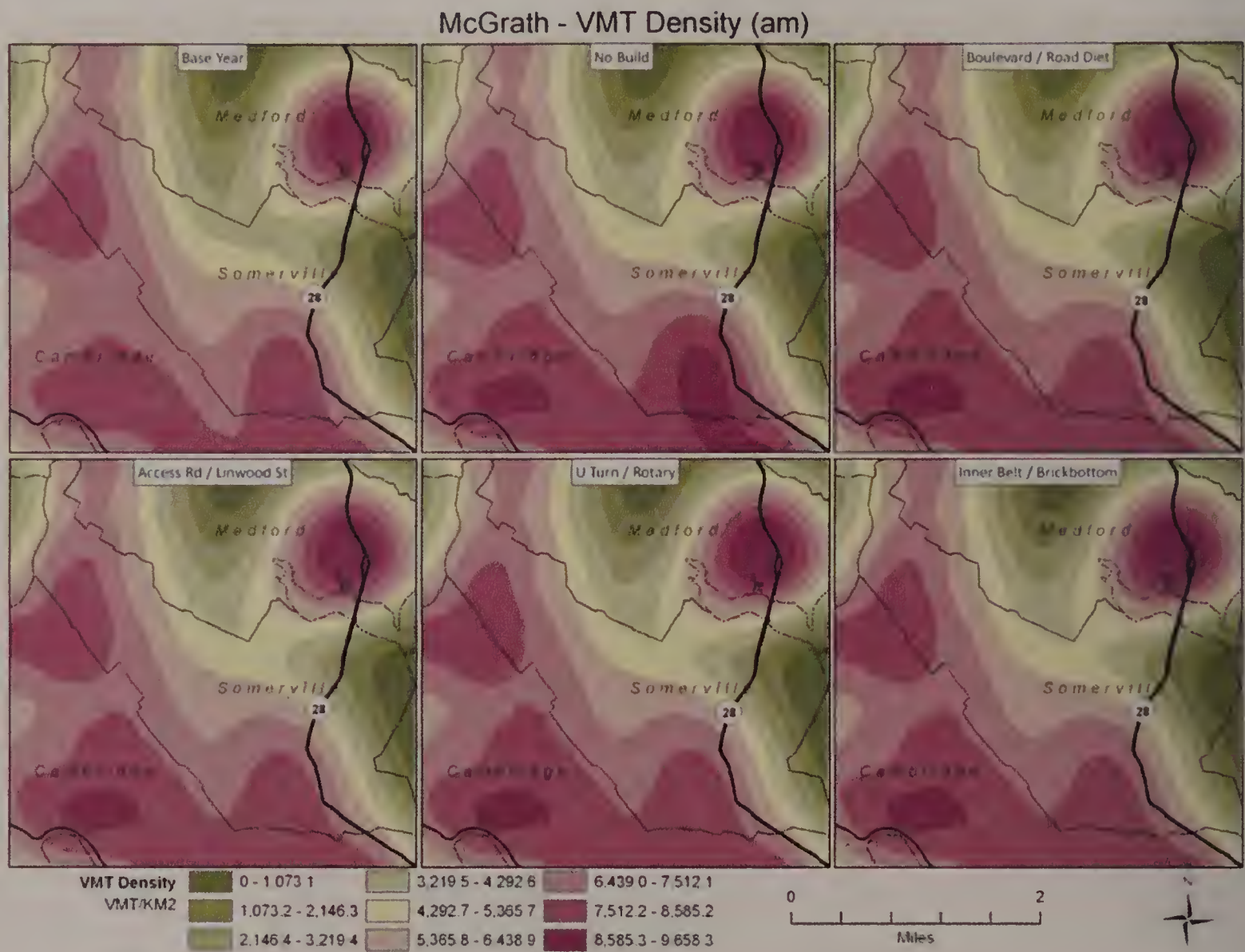




FIGURE 6-C: PREDICTED NO<sub>x</sub> CONCENTRATIONS (MORNING PEAK)

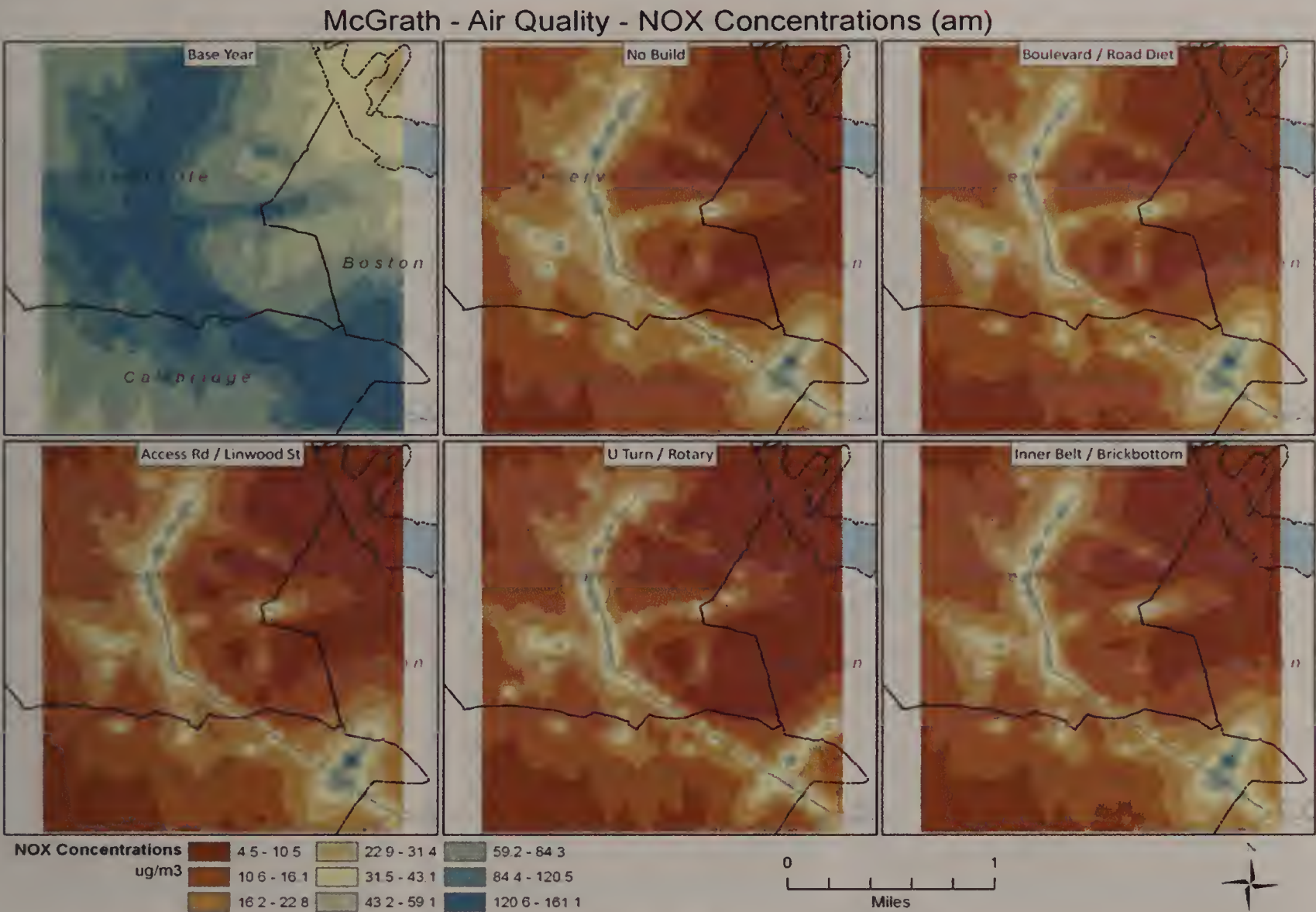


FIGURE 6-D: PREDICTED PM<sub>2.5</sub> CONCENTRATIONS (MORNING PEAK)

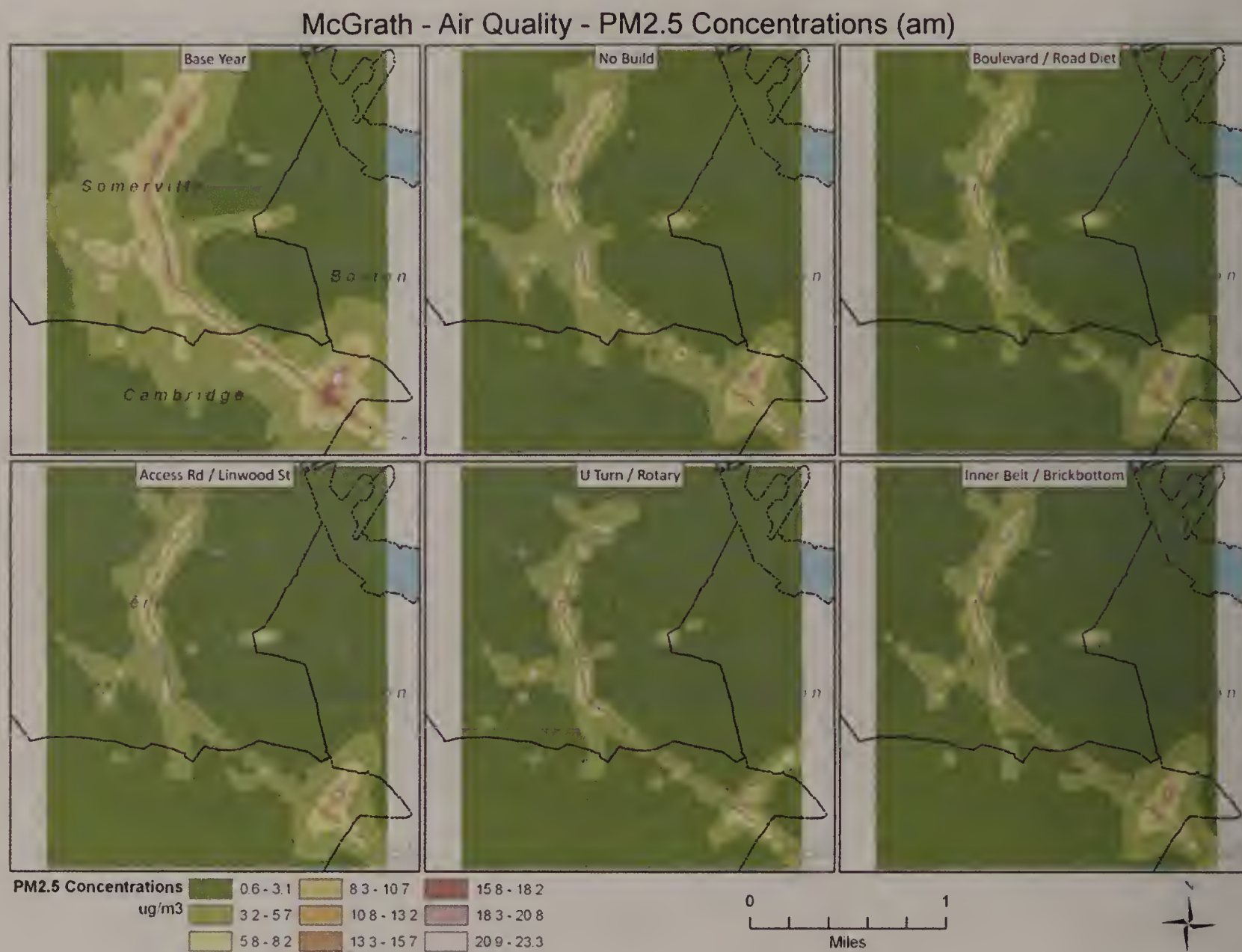
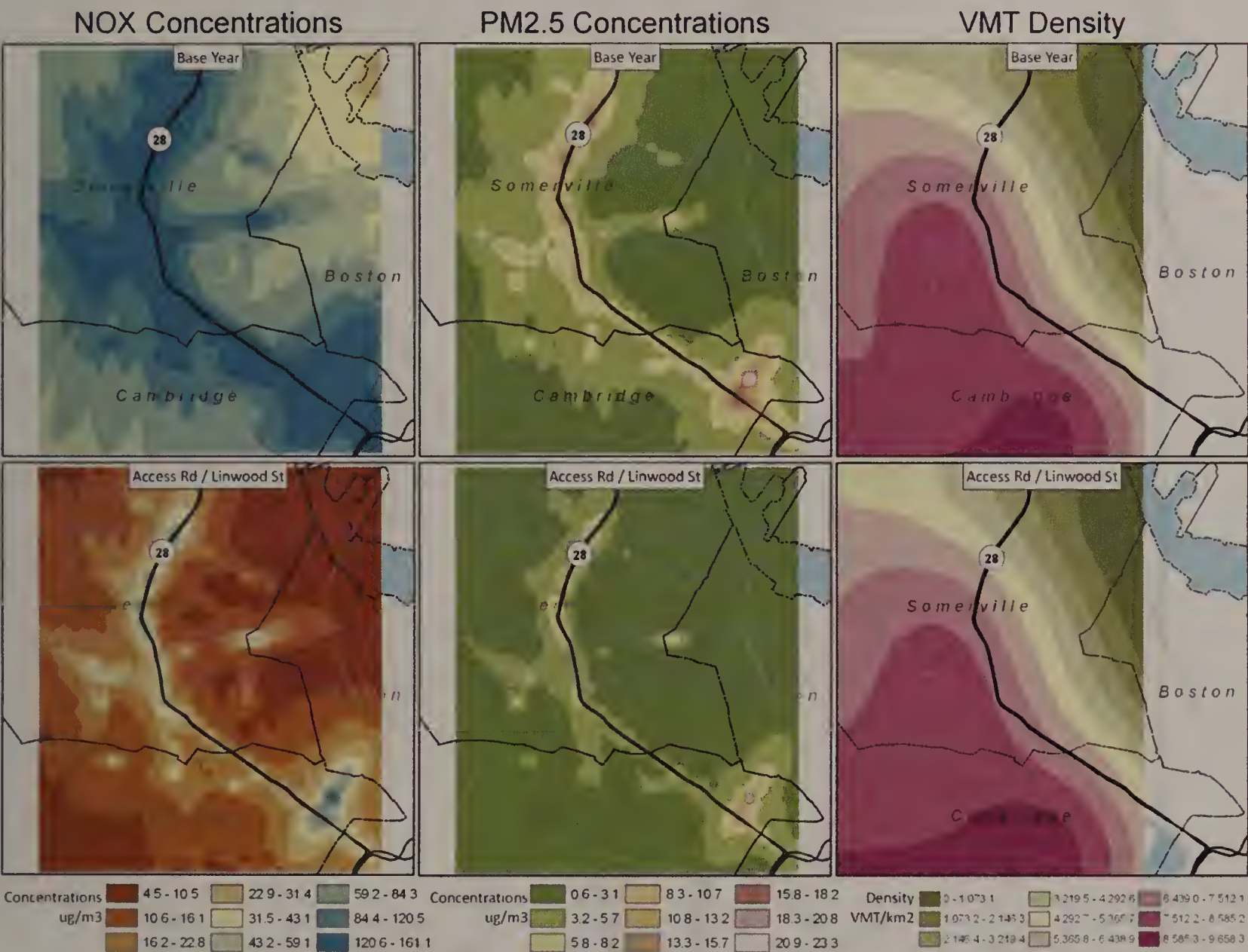




FIGURE 6-E: COMPARISON OF PREDICTED NO<sub>x</sub> AND PM<sub>2.5</sub> CONCENTRATION AND TRAFFIC DENSITY CONTROLS



**FIGURE 6-F: PEQI SCORES FOR EXISTING ROADS AND IDENTIFICATION OF PROPOSED FUTURE SIDEWALKS AND COMMUNITY PATH**











FIGURE 6-I: BEQI SCORES OF FUTURE BIKE PATH AND COMMUNITY PATH



FIGURE 6-J: TWO ROUTES EVALUATED FOR MODE SHIFT IN GM HIA

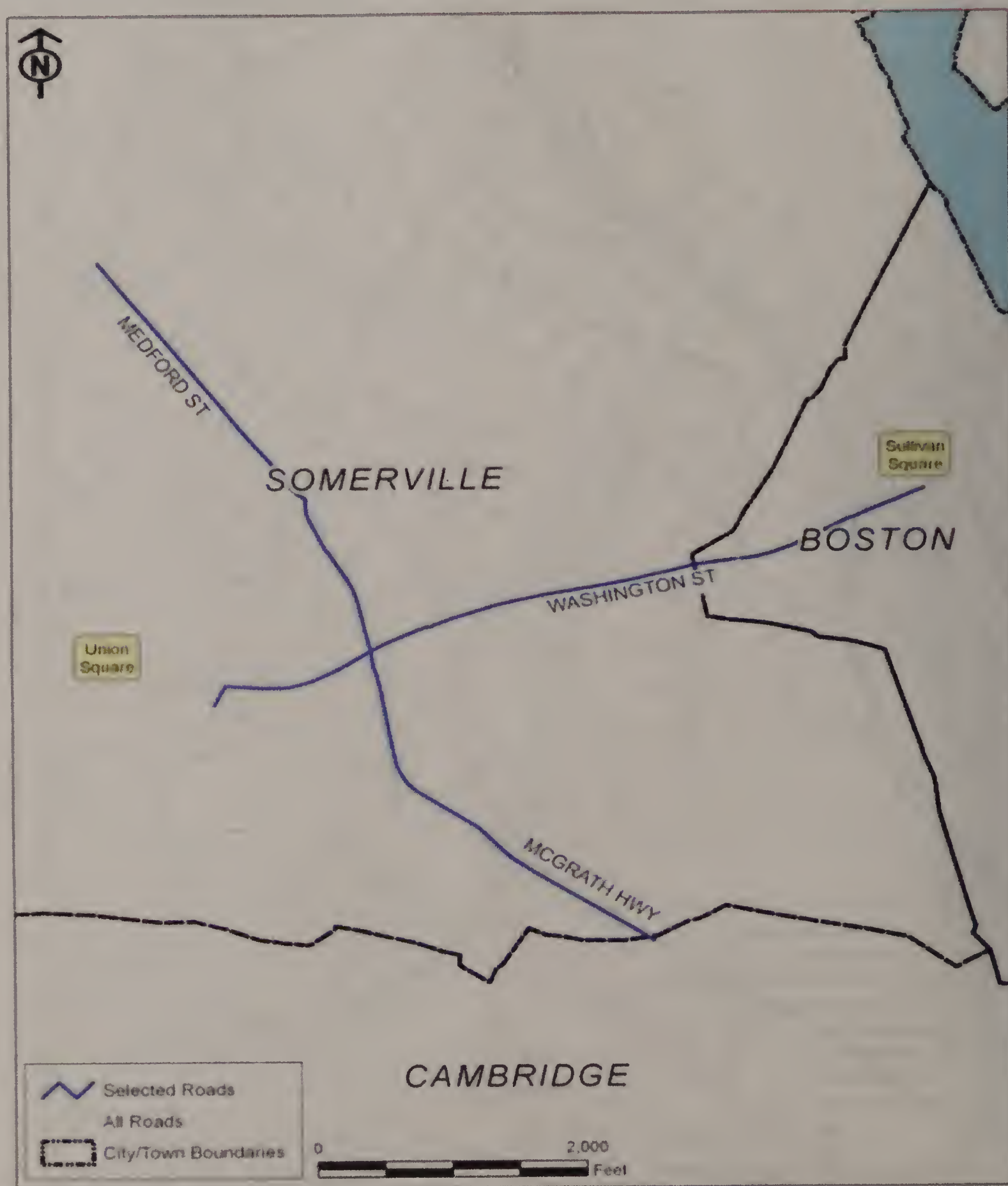




FIGURE 6-K: GOODS AND SERVICES McGRATH HIGHWAY STUDY AREA

McGrath HIA - Goods & Services Within 1/4 Mile  
Rotary Uturn Hybrid Alternative





FIGURE 6-L: HOUSEHOLDS WITHIN 0.5 MILES OF SELECTED POINTS

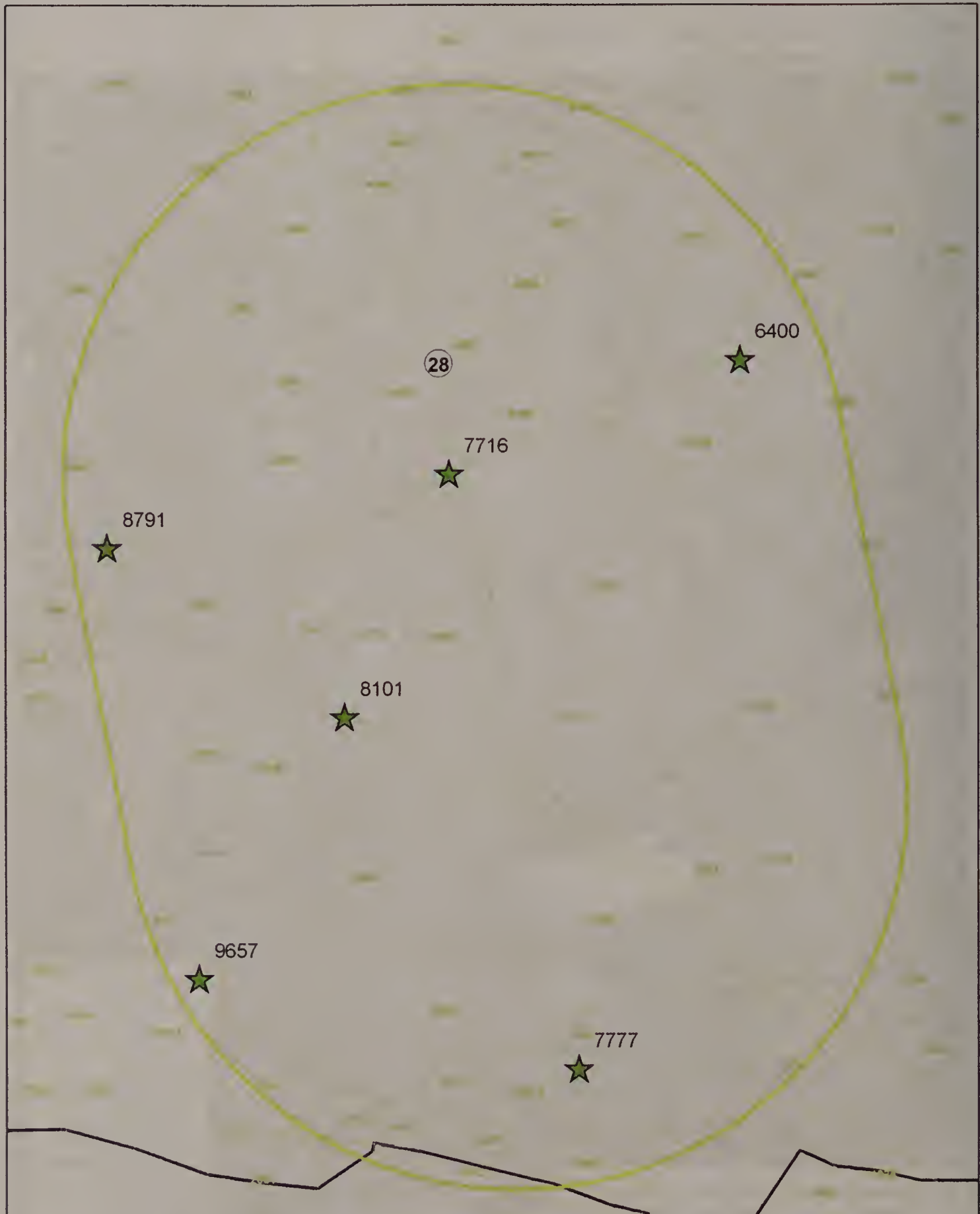
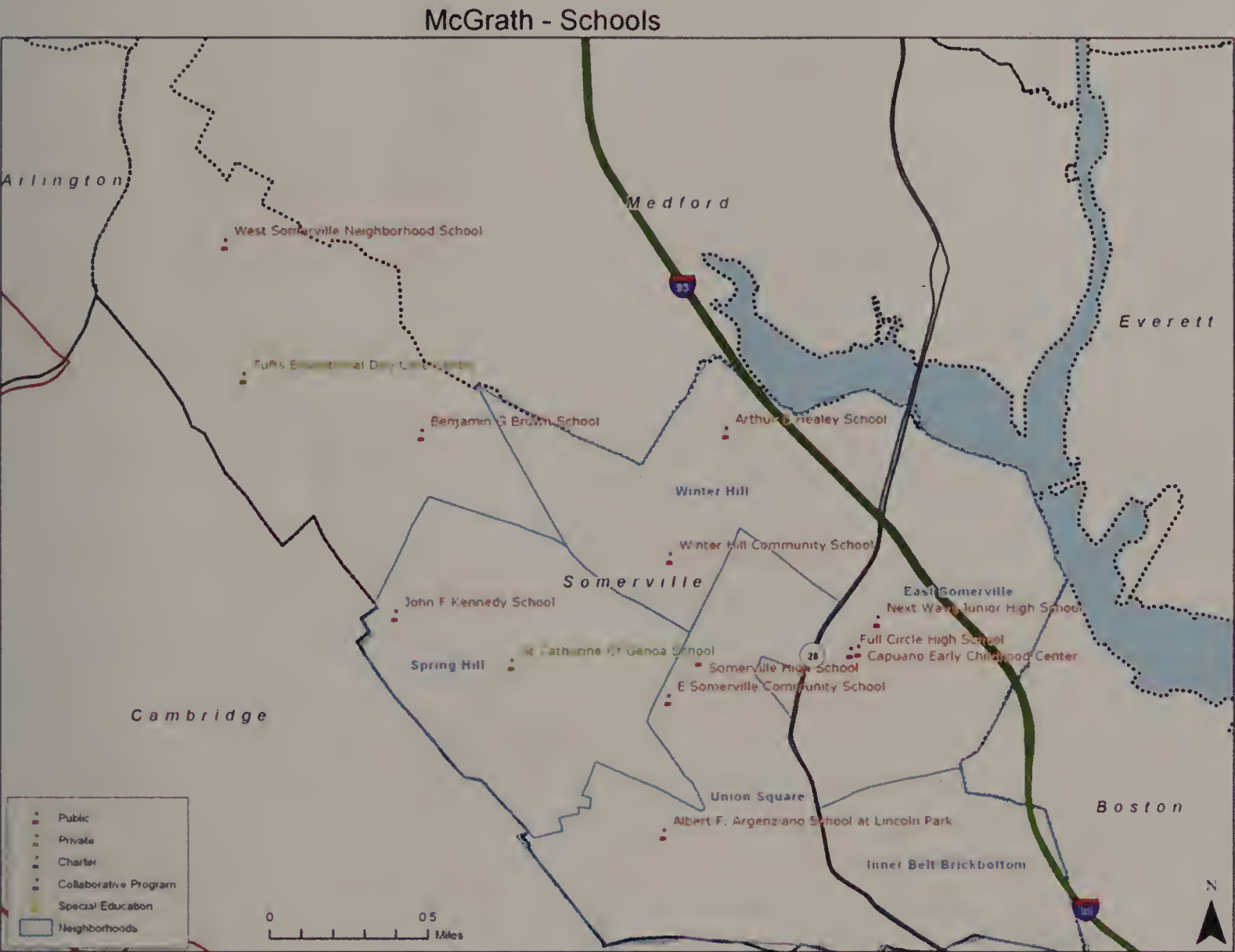




FIGURE 6-M: K-8 SCHOOLS IN SOMERVILLE



## 7. LIMITATIONS

The following limitations were identified:

- The HIA is focused on the future of the McGrath Highway and thus does not address the current structure of the McGrath Highway.
- Only alternatives proposed in the MassDOT GM Study were evaluated.
- Most health outcome data were limited to zip code level to evaluate impacts in the study area.
- Air quality impacts are based on analysis of two criteria pollutants as surrogate for the complex mixture of traffic-related air pollutants.
- The air quality dispersion analysis was limited to morning and evening 3 hour peak emissions data from CTPS Travel Demand Model.
- The CTPS Travel Demand Model limitations include:
  - Travel preferences were from a 1991 survey
  - 2010 census data was not fully incorporated into the TDM-projections.
  - Population and economic projections to 2035 are subject to economic projections that may change
  - Emissions data are based on Mobile 6.2 and may change significantly when this model is replaced by the Motor Vehicle Emissions Simulator model (MOVES).
  - Data on the assumptions regarding transportation modes, demographics, economics, etc. that drive the model were not readily available.
  - Data were not available to evaluate the impact of Green Line Extension and Inner Belt/Brickbottom development plan had on the modeling assumptions.
- Noise modeling was not conducted by MassDOT as part of the MassDOT GM Study. Screening Modeling conducted by MDPH/BEH was limited in scope and simplified to reflect 'worst case' conditions, including peak one-hour traffic volumes. In addition, the impact of noise levels associated with congestion was not considered.
- Assessing Mobility and Connectivity was limited to general identification of design elements associated with MassDOT guidelines (e.g., Complete Streets).
- Travel time and congested time calculations were based upon the CTPS Travel Demand Model output, which did not include delays at intersections along McGrath Highway. Thus, the travel time is underestimated.



- Drawings for the alternative designs from the Grounding McGrath Study were incomplete at the time this HIA was prepared, and could not be fully incorporated into the GIS analysis.
- Assessment of land use and economic development was significantly limited because the MassDOT GM Study did not quantify the impacts of the Green Line Extension and Inner Belt/Brickbottom development.

## 8. FINDINGS AND RECOMMENDATIONS

MDPH/BEH makes the following recommendations regarding the development of a framework and methods for conducting HIAs for transportation planning projects:

- Future assessment of health impacts and benefits of proposed project alternatives should be conducted once more robust project-specific information and transportation data become available. Conducting an HIA in tandem with the first phase of a transportation planning study is informative but is limited.
- Conducting an HIA in tandem with the first phase of a transportation planning study can provide good preliminary information on health impacts at an early stage of project development. However, a more detailed and precise assessment of health impacts and benefits of proposed project alternatives would be possible at a later stage of project development, once more robust project-specific information and transportation data become available.
- When available, traffic density information can provide a reasonable surrogate for exposure to traffic-related pollutant emissions and should be considered as a viable screening tool in the early phases of the transportation planning process and a potential alternative to more resource intensive air quality modeling efforts.

The following project-specific recommendations were generated based on the assessment of public health impacts/benefits associated with the pilot GM HIA project:

### *Air Quality*

- All future project alternatives, including the 2035 No-build, will result in significant reductions in traffic-related air pollution largely attributed to advancements in vehicle emissions standards and technologies. Continued support for the implementation of MassDEP efforts to reduce motor-vehicle related emissions including the Low Emissions Vehicle (LEV) program, emission control retrofits on diesel buses and construction equipment, and vehicle inspection programs may further improve both local and regional air quality.

- De-elevation of the highway structure is anticipated to result in an increase in ground-level exposure to traffic-related air pollutant emissions (i.e., criteria pollutants, hazardous air pollutants, ultrafine particles). Thus, implementation of mitigation measures (e.g., locating sidewalks and bike paths further away from the roadway, installation of barriers, planting of trees) based on more comprehensive assessment of air pollution impacts should be explored where possible to reduce exposure to traffic related air pollutants.
- CTPS is expected to update the travel survey data and model used to estimate emissions in the Travel Demand Model. As a result, a sensitivity analysis to determine if major changes to the model output will occur when the Travel Demand Model is updated should be considered.

### *Noise*

- Although a screening-level analysis of noise impacts in an area with the highest predicted traffic volumes indicated higher noise impacts would be expected with a de-elevated highway structure. A more comprehensive analysis of noise impacts to sensitive receptors from de-elevating the highway within the buffer area is recommended in order to identify areas where noise mitigation may be warranted.

### *Mobility and Connectivity*

- Although detailed designs of all four future alternatives have not been developed at this stage of the MassDOT GM Study, it is anticipated that all future pedestrian and bicycling networks will conform to the Complete Streets Guidelines and incorporate high quality design elements associated with active transportation. Efforts to support and maintain improvements to the pedestrian and bicycling network including providing accessibility to disabled residents are critical. In addition, support for a multifaceted approach to increase active transportation choices within the neighborhoods is vital including consideration of cultural preferences and demographic diversity in Somerville, as well as socioeconomic status of residents.

### *Public Safety*

- Recommendations by DPH in the Highway Safety Plan to reduce injuries and fatalities should be incorporated into alternative designs.
- Efforts to support reduced travel speeds and volumes both on the de-elevated highway and in nearby neighborhoods will decrease injuries and fatalities.
- Developing and promoting plans with local law enforcement to ensure safety along sidewalks, the bike path and open space will increase likelihood of selecting active transportation options.



### *Land Use and Economic Development*

- Given that the study area is classified as an environmental justice community it is critical that long-term plans that involve current residents are developed to ensure affordability of goods and services, stabilization of cost of rental apartments, and employment opportunities are made available.

## **9. REPORTING, EVALUATION AND MONITORING**

### *Reporting*

As discussed in Chapter 4, after internal review, the findings and initial recommendations of the GM HIA will be presented to the GM Working Group in early 2013 before the final draft HIA undergoes a 30-day public comment period. Additional reporting will occur at MassDOT GM Study public meetings, briefing to Healthy Transportation Compact, and others. Plans for disseminating the results of the HIA will be determined in consultation with MassDOT and stakeholders.

### *Monitoring*

Monitoring is intended to track the impacts of the HIA on the decision making process and decision, the implementation of the decision, and impacts of the decision on health determinants. Given that the projected implementation of the MassDOT GM Study recommendations is 2035, initial monitoring will address incorporation of the HIA recommendations into the MassDOT GM Study and the success in reporting the findings of the HIA to stakeholders and the public. This includes the comments and responses from the review of the final draft GM HIA during public comment period.

### *Evaluation*

The following evaluation criteria have been proposed:

- Success in training of Massachusetts DOT and DPH leadership and staff. Survey decision-makers on how useful the information was in their deliberations.
- Success at selecting a pilot project that demonstrates the usefulness of HIAs for transportation and health planners will use in future projects.
- Incorporation of HIA recommendations into the MassDOT GM Study.
- Stakeholder-driven approach for incorporating HIA methods into transportation projects that would benefit from an HIA.
- Number of future transportation-related projects that consider the HIAs in their decision-making process

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